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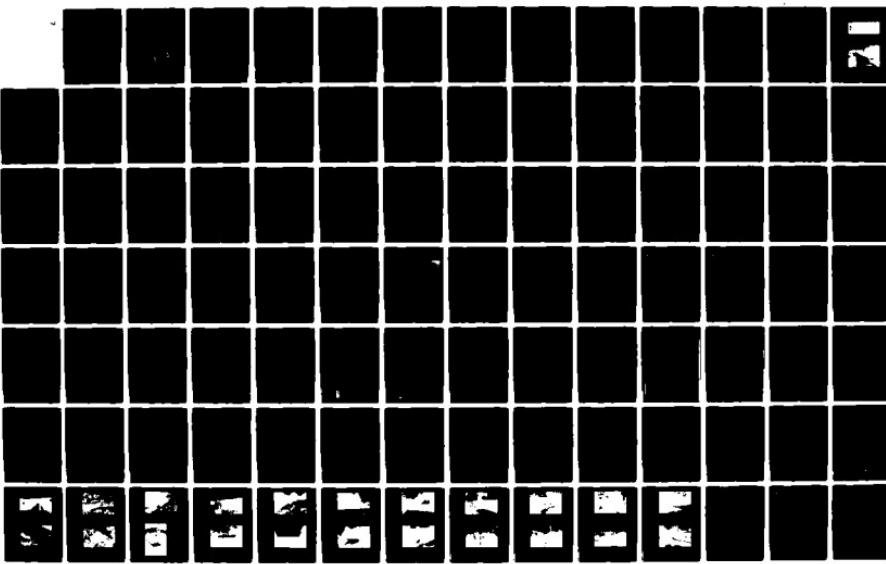
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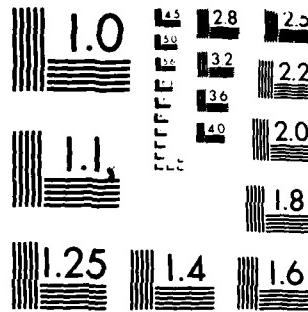
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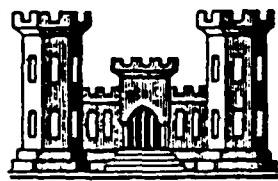
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PARK RIVER BASIN
WEST HARTFORD, CONNECTICUT

HARTFORD RESERVOIR NO. I DAM
CT 00001

PHASE I INSPECTION REPORT
NATIONAL DAM INSPECTION PROGRAM

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REPORT DOCUMENTATION PAGE		READ INSTRUCTIONS BEFORE COMPLETING FORM
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4. TITLE (and Subtitle) HARTFORD RESERVOIR NO. 1 DAM; PARK RIVER BASIN WEST HARTFORD, CONNECTICUT NATIONAL PROGRAM FOR INSPECTION OF NON-FEDERAL DAMS	5. TYPE OF REPORT & PERIOD COVERED INSPECTION REPORT	
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9. PERFORMING ORGANIZATION NAME AND ADDRESS	10. PROGRAM ELEMENT, PROJECT, TASK AREA & WORK UNIT NUMBERS	
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19. KEY WORDS (Continue on reverse side if necessary and identify by block number) DAMS, INSPECTION, DAM SAFETY, PARK RIVER BASIN HARTFORD CONN.		
20. ABSTRACT (Continue on reverse side if necessary and identify by block number) HARTFORD RESERVOIR No. 1 DAM IS A 113-YEAR OLD EARTH EMBANKMENT, APPROXIMATELY 500 FEET LONG WITH A MAXIMUM HEIGHT OF 42 FEET, WHICH CURRENTLY IMPOUNDS WATER FOR USE AT A DOWNSTREAM POWER GENERATION FACILITY. IT IS ESTIMATED THAT ENOUGH SURPLUS WATER FROM THE IMPOUNDMENT IS AVAILABLE TO OPERATE THE POWER FACILITIES BETWEEN 40 TO 60% OF THE YEAR. POWER PRODUCED AT THE FACILITY IS USED AT A NEARBY WATER FILTRATION PLANT. NO. 1 DAM APPEARED TO BE IN FAIR CONDITION. HOWEVER, SEVERAL DEFICIENCIES WERE OBSERVED DURING THE INSPECTION. A PERMANENTLY SATURATED CONDITION EXISTS AT THE DOWNSTREAM TOE WHICH HAS BEEN PARTIALLY CORRECTED. A DOWNTURN IN THE RIVER BANK EXISTED AT THE DOWNSTREAM TOE.		



DEPARTMENT OF THE ARMY
NEW ENGLAND DIVISION, CORPS OF ENGINEERS
424 TRAPELO ROAD
WALTHAM, MASSACHUSETTS 02154

REPLY TO
ATTENTION OF
NEDED

MAY 30 1980

Honorable Ella T. Grasso
Governor of the State of Connecticut
State Capitol
Hartford, Connecticut 06115

Dear Governor Grasso:

Inclosed is a copy of the Hartford Reservoir No. 1 Dam Phase I Inspection Report, which was prepared under the National Program for Inspection of Non-Federal Dams. This report is presented for your use and is based upon a visual inspection, a review of the past performance and a brief hydrological study of the dam. A brief assessment is included at the beginning of the report. I have approved the report and support the findings and recommendations described in Section 7 and ask that you keep me informed of the actions taken to implement them. This follow-up action is a vitally important part of this program.

A copy of this report has been forwarded to the Department of Environmental Protection, the cooperating agency for the State of Connecticut. In addition, a copy of the report has also been furnished the owner, Metropolitan District, Hartford, Connecticut 06101.

Copies of this report will be made available to the public, upon request, by this office under the Freedom of Information Act. In the case of this report the release date will be thirty days from the date of this letter.

I wish to take this opportunity to thank you and the Department of Environmental Protection for your cooperation in carrying out this program.

Sincerely,

Max B. Scheider
MAX B. SCHEIDER
Colonel, Corps of Engineers
Division Engineer

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JUL 2 1984
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Incl
As stated

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HARTFORD RESERVOIR NO. 1 DAM

CT 00001

PARK RIVER BASIN
HARTFORD, CONNECTICUT

PHASE 1 INSPECTION REPORT

NATIONAL DAM INSPECTION PROGRAM

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NATIONAL DAM INSPECTION PROGRAM

PHASE I INSPECTION REPORT

Identification No.: CT00001
Name of Dam: Hartford Reservoir No. 1
Town: West Hartford
County and State: Hartford County, Connecticut
Stream: Spice Brook
Date of Inspection: November 13, 1979

BRIEF ASSESSMENT

Hartford Reservoir No. 1 Dam is a 113-year old earth embankment, approximately 500 feet long with a maximum height of 42 feet, which currently impounds water for use at a downstream power generation facility.

It is estimated that enough surplus water from the impoundment is available to operate the power facilities between 40 and 60 percent of the year. Power produced at the facility is used at a nearby water filtration plant.

From 1867 to 1922 the reservoir functioned as part of the Hartford water supply system. In case of emergency, the reservoir could still be used to supplement the water supply system.

The watershed area for Hartford Reservoir No. 1 Dam encompasses approximately 3.9 square miles of mostly forested, mountainous land. With the water level at the primary spillway crest, Reservoir No. 1 covers approximately 27 acres and provides a storage capacity of 284 acre-feet. The maximum storage capacity of the reservoir is 619 acre-feet. Hartford Reservoirs 2, 3 and 5 are also located within the watershed and, in conjunction with Reservoir No. 1, account for 6 percent of the surface area.

Due to the 42-foot height of the dam, Hartford Reservoir No. 1 is classified in the "Intermediate" size category. The initial potential damage area in the event of a dam breach is the power generation facility located 100 feet downstream of the dam. The first residential hazard area is located about 2,000 feet downstream of the dam. A failure of the dam would result in excessive property damage at both of these locations and the possible loss of more than a few lives in the residential hazard area. Therefore, the dam is classified in the "High" hazard potential category. The recommended test flood for an "Intermediate" size, "High" hazard dam is the full Probable Maximum Flood (PMF).

The test flood peak inflow to Hartford Reservoir No. 1 was computed to be 5,590 cfs. The routed test flood outflow of 5,440 cfs would be contained below the top of the dam by 0.5 feet. The spillway system is capable of discharging 100 percent of the routed test flood outflow.

On the date of the inspection, Hartford Reservoir No. 1 Dam appeared to be in fair condition. However, several deficiencies were observed during the inspection. A permanently saturated condition exists at the downstream toe which has been partially corrected with the installation of a portion of the toe drain system. A depression of the downstream face of the embankment extends from the crest to the toe of the dam in the vicinity of the outlet works. An undulated area at the downstream toe of the slope was also observed. Animal burrow holes were observed in the downstream face, and trees are growing in the vicinity of the downstream toe and in the abutment regions. Some riprap has been displaced from the upstream face of the dam.

Within one year after receipt of this Phase I Inspection Report, the Owner should retain the services of a qualified registered professional Engineer to direct the removal of the trees in the vicinity of the abutments and at the toe of the downstream face of the dam. Voids left in the embankment by the removal of the trees should be filled with suitable, thoroughly compacted material.

The Owner should implement the following operation and maintenance measures: (1) Complete all work on the toe drain system; (2) the disturbed area at the downstream toe of the dam and the depression in the downstream face should be regraded and reseeded and monitored for future movement; (3) The stone riprap on the upstream face of the dam should be replaced where necessary; (4) Animal burrows on the downstream face of the dam should be backfilled; (5) A formal flood warning plan should be developed; and (6) a program of annual periodic technical inspection should be instituted.

O'BRIEN & GERE ENGINEERS, INC.

John J. Williams
John J. Williams, P.E.
Vice President
New York Registration No. 050794



28 April 1980

This Phase I Inspection Report on Hartford Reservoir No. 1 Dam has been reviewed by the undersigned Review Board members. In our opinion, the reported findings, conclusions, and recommendations are consistent with the Recommended Guidelines for Safety Inspection of Dams, and with good engineering judgment and practice, and is hereby submitted for approval.

CARNEY M. TERZIAN

CARNEY M. TERZIAN, MEMBER
Design Branch
Engineering Division

RICHARD J. DIBONO

RICHARD DIBONO, MEMBER
Water Control Branch
Engineering Division

ARAMAST MAHTESIAN

ARAMAST MAHTESIAN, CHAIRMAN
Geotechnical Engineering Branch
Engineering Division

APPROVAL RECOMMENDED:

JOE B. FRYAR
JOE B. FRYAR
Chief, Engineering Division

PREFACE

This report is prepared under guidance contained in the Recommended Guidelines for Safety Inspection of Dams, for Phase I Investigations. Copies of these guidelines may be obtained from the Office of Chief of Engineers, Washington, D.C. 20314. The purpose of a Phase I Investigation is to identify expeditiously those dams which may pose hazards to human life or property. The assessment of the general condition of the dam is based upon available data and visual inspections. Detailed investigation, and analyses involving topographic mapping, subsurface investigations, testing, and detailed computational evaluations are beyond the scope of a Phase I investigation; however, the investigation is intended to identify any need for such studies.

In reviewing this report, it should be realized that the reported condition of the dam is based on observations of field conditions at the time of inspection along with data available to the inspection team. In cases where the reservoir was lowered or drained prior to inspection, such action, while improving the stability and safety of the dam, removes the normal load on the structure and may obscure certain conditions which might otherwise be detectable if inspected under the normal operating environment of the structure.

It is important to note that the condition of a dam depends on numerous and constantly changing internal and external conditions, and is evolutionary in nature. It would be incorrect to assume that the present condition of the dam will continue to represent the condition of the dam at some point in the future. Only through continued care and inspection can there be any chance that unsafe conditions be detected.

Phase I inspections are not intended to provide detailed hydrologic and hydraulic analyses. In accordance with the established Guidelines, the Spillway Test flood is based on the estimated "Probable Maximum Flood" for the region (greatest reasonably possible storm runoff), or fractions thereof. Because of the magnitude and rarity of such a storm event, a finding that a spillway will not pass the test flood should not be interpreted as necessarily posing a highly inadequate condition. The test flood provides a measure of relative spillway capacity and serves as an aid in determining the need for more detailed hydrologic and hydraulic studies, considering the size of the dam, its general condition and the downstream damage potential.

The Phase I Investigation does not include an assessment of the need for fences, gates, no-trespassing signs, repairs to existing fences and railings and other items which may be needed to minimize trespass and provide greater security for the facility and safety to the public. An evaluation of the project for compliance with OSHA rules and regulations is also excluded.

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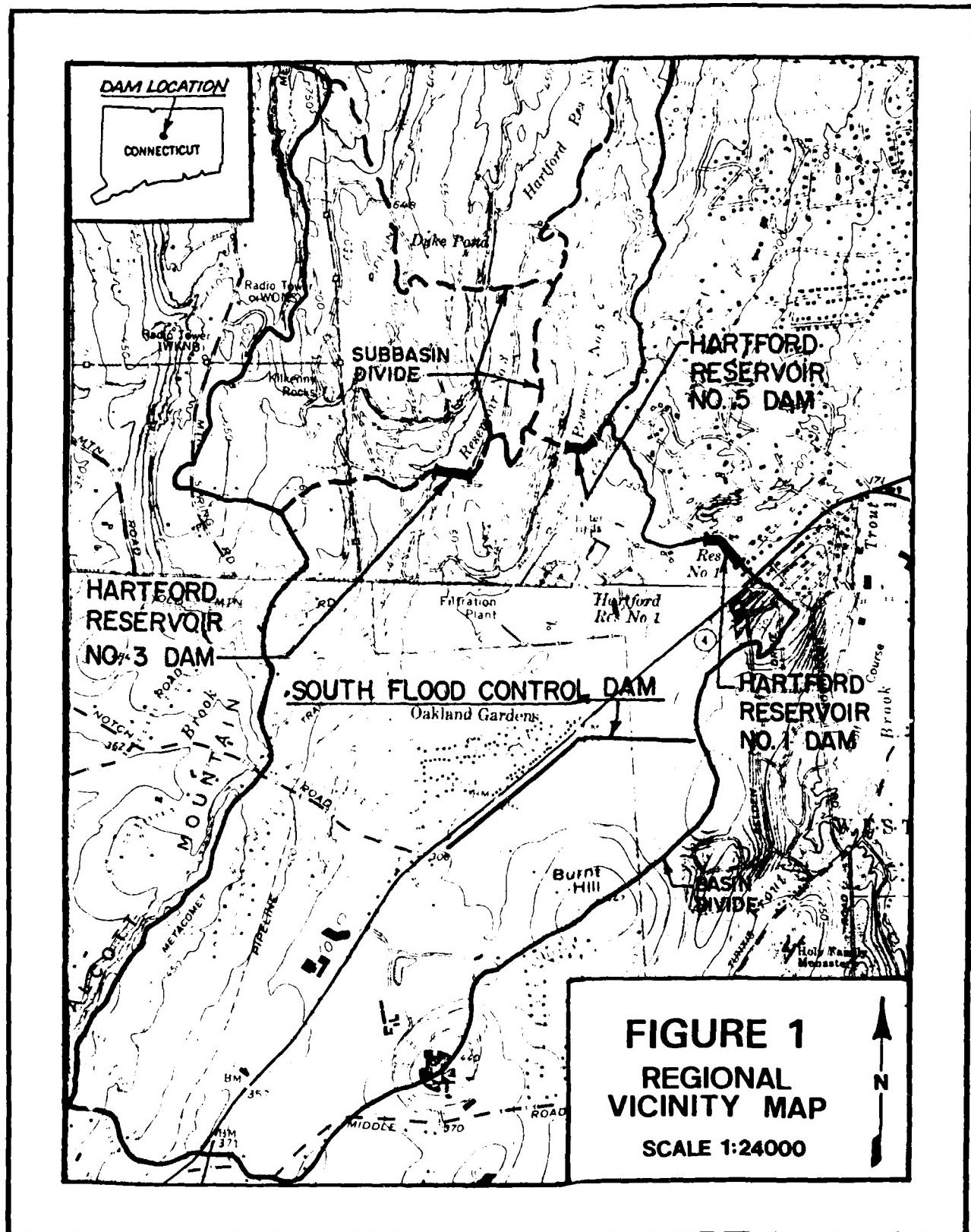
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UPSTREAM OVERVIEW AS OBSERVED FROM THE RIGHT ABUTMENT. (11/13/79)



DOWNSTREAM OVERVIEW AS OBSERVED FROM THE RIGHT ABUTMENT. (11/13/79)



NATIONAL DAM INSPECTION PROGRAM
PHASE I INSPECTION REPORT
HARTFORD RESERVOIR NO. 1 DAM

SECTION 1

PROJECT INFORMATION

1.1 General

a. Authority. The National Dam Inspection Act (Public Law 92-367) was passed by Congress on August 8, 1972. Under this Act, the Secretary of the Army was authorized to initiate, through the Corps of Engineers, the National Program for Inspection of Dams throughout the United States. Responsibility for supervising inspection of dams in the New England Region has been assigned to the New England Division of the Corps of Engineers.

O'Brien & Gere Engineers, Inc. has been retained by the New England Division to inspect and report on selected non-federal dams in the State of Connecticut. Authorization and Notice to Proceed were issued to O'Brien & Gere by a letter dated November 6, 1979 and signed by Col. William E. Hodgson, Jr. Contract No. DACW 33-80-C-0014 has been assigned by the Corps of Engineers for this work.

b. Purpose. The purpose of inspecting and evaluating non-federal dams is to:

1. Identify conditions which threaten public safety and make the Owner aware of any deficiencies so that he may correct them in a timely manner.

2. Encourage and prepare the State to initiate an effective dam safety program for non-federal dams as soon as possible.

3. Update, verify and complete the National Inventory of Dams.

1.2 Description of Project (Information with regard to this dam was obtained from the Hartford, Connecticut, Metropolitan District).

a. Location. Hartford Reservoir No. 1 Dam is located on Spice Brook in the Town of West Hartford, Connecticut. Spice Brook flows into Trout Brook an estimated 4,000 feet downstream of the dam. Trout Brook discharges into the South Branch of Park River about 8 miles downstream of the dam. To illustrate the location of the structure, portions of the USGS quadrangle maps entitled "Avon, Conn." and "New Britain, Conn." have been incorporated and included as Figure 1 on page vi of this report, USGS reference coordinates for this dam are N41°45.1' and W72°046.5'.

The initial damage center is the Metropolitan District power generating facilities 100 feet downstream from the dam. The initial residential flood impact area is an estimated 2,000 feet downstream from the dam. Many residential flood impact areas are located in the ensuing miles along Trout Brook.

b. Description of Dam and Appurtenances. The dam is located on the north-eastern side of Hartford Reservoir No. 1. It is an earth embankment approximately 500 feet long with a maximum height of 42 feet. The dam has the following major features:

1. The upstream grass-covered face of the dam is on a slope of approximately 3H:1V. The lower portion of the upstream face of the dam, extending from an elevation of about 3 feet above pool elevation to an undetermined depth beneath the water surface, is protected with small riprap stones.

2. The dam crest is approximately 25 feet wide. A 14-foot wide paved road is located along the crest of the dam with a row of shrubbery on each side of the roadway.

3. The downstream face of the dam is on a slope of approximately 2H:1V and is grass-covered.

A section drawing and several photos of the features described above have been included in Appendix B and Appendix C, respectively.

The primary spillway is located at the northwestern end of the reservoir. The inlet consists of a 45-foot wide concrete weir and the outlet consists of a stone-lined channel about 20 feet wide and 1,700 feet long which outlets into Spice Brook an estimated 800 feet downstream of the dam.

A 108-foot wide auxiliary (emergency) spillway is located just to the left of the left abutment of the dam. This spillway is grass-covered and partially formed by a gabion wall along its right side. The elevation of the auxiliary spillway is an estimated 5.4 feet above the primary spillway elevation. Further information relative to the spillways is given in Appendices B, C and D.

The outlet works provide a means of conveying water to the downstream power generation facilities in addition to providing a means of draining the reservoir. The inlet facilities for the outlet works are located in the intake structure near the right abutment of the dam (constructed in 1978) and in the intake tower in the impoundment near the center of the dam. The outlet facilities are located in a gatehouse immediately downstream. Further downstream, a gate chamber houses valves which direct the flow towards the power generating facilities or towards Spice Brook.

c. Size Classification. Hartford Reservoir No. 1 Dam has a maximum height of 42 feet which places it in the "Intermediate" size category for height because it is greater than 40 feet but not greater than 100 feet high. It falls into the "Small" size category for storage because its maximum storage capacity of 619 acre-feet is less than the 1,000 acre-foot upper limit for "Small" size structures. Since the dam is considered "Intermediate" in size for height, it must be classified in the "Intermediate" size category for this report.

d. Hazard Classification. Several areas downstream of the dam could be identified as potential flood impact zones. The initial damage center is the Metropolitan District power generating facilities 100 feet downstream of the dam. These facilities would probably be destroyed by floodwaters resulting from a dam failure. The first residential area is located approximately 2,000 feet downstream of the dam near the point where Spice Brook flows under Old Mill Lane. The sill elevation of the lowest houses at this location was estimated to be 2 feet above the channel banks of the stream. The failure analysis indicated that a breach of Hartford Reservoir No. 1 Dam with the reservoir surface at the test flood elevation (0.5 feet below the top of the dam) would result in a flow depth of 5.7 feet above the channel banks, or 3.7 feet above the sill elevation of the lowest houses, at this initial residential damage area. A flood of this magnitude would cause excessive property damage and possible loss of life in this location. The failure analysis also indicated that a breach of the dam with the reservoir surface at the spillway crest would result in a flow depth of 2.8 feet above the low sill elevation, which would also cause excessive property damage and the possible loss of more than a few lives. Several other residential areas are located further downstream and could also be subjected to damage. The depth of flow immediately prior to failure was computed to be 1.7 feet above the low sill elevation with the reservoir at the top of the dam and estimated at 3.5 feet below the low sill elevation with the reservoir surface at the spillway crest. Therefore, a significant increase in hazard to loss of life downstream would result from a failure of the dam. Due to the conditions described above, Hartford Reservoir No. 1 is classified in the "High" hazard category.

e. Ownership. The dam is owned by the Metropolitan District, 555 Main Street, Hartford, Connecticut, 06101; Telephone: 203-278-7850.

f. Operator. Mr. Richard Allen, Purification Engineer for the Hartford Metropolitan District, is responsible for operation of the West Hartford reservoir system. His address is Metropolitan District, 555 Main Street, P.O. Box 800, Hartford, Connecticut, 06101; Telephone: 203-278-7850, ext. 332.

g. Purpose of Dam. The dam was originally constructed for Hartford water supply purposes. Since 1922, however, water from Reservoir No. 1 Dam has been primarily used to drive turbines for the production of hydroelectric power. In case of emergency, the reservoir could be used to supplement the water supply reservoirs.

h. Design and Construction History. The dam was originally constructed between 1864 and 1867 and was subsequently rebuilt in 1868. Modifications to the project, since that time, include the power generating facilities including the 30-inch diameter transfer pipe which was constructed in 1922, the raising of the primary spillway crest one foot and the construction of the auxiliary spillway in 1967 and the partial installation of the toe drain system and the reconstruction of the intake structure on the 30-inch transfer pipe, which carries water to the power generation facilities, in 1978 and 1979. According to Mr. Allen, details of the original design and construction are not available.

i. Normal Operating Procedures. According to Mr. Allen, discharge from Reservoir No. 1 is normally directed to the power generation facility located about 100 feet downstream of the dam. Depending upon precipitation, flows for this purpose are generally available for 40 to 60 percent of the year. The primary spillway, whose crest was 1.5 feet above the reservoir surface at the time of inspection, is used only when all available upstream storage has been exhausted.

In anticipation of excessive runoff, personnel from the Metropolitan District will open valves on the low level discharge pipes to help lower the reservoir surface. However, Mr. Allen feels that such operations do not accomplish a great deal other than to exercise the valves.

1.3 Pertinent Data

a. Drainage Area. The area draining to Hartford Reservoir No. 1 encompasses 3.9 square miles of primarily forested, mountainous land. Included in this area are Hartford Reservoir Nos. 1, 2, 3 and 5 which account for about 6 percent of the drainage area. Elevations range from 800 along the Talcott Mountain Range to 256.5 at the normal reservoir surface of Hartford Reservoir No. 1.

b. Discharge at Damsite.

1. Outlet Works. Water may be drawn from the reservoir at two locations. One outlet is a set of two 24-inch diameter gate controlled pipes which originate in the intake tower and convey water to the gate house. Valves in the gate house may be opened to allow for the discharge to continue via twin 20-inch diameter pipes to a gate chamber located next to the power generation building. In the gate chamber discharge can be turned off, directed to the power generation facility, or diverted to Spice Brook. The estimated discharge capacity of the twin outlet pipes with the reservoir surface at the top of the dam is 190 cfs.

The second outlet consists of a 30-inch diameter cast iron pipe which extends from a new intake structure located at the right abutment of the dam to the gate chamber located next to the power generation building. The estimated discharge capacity of this pipe with the reservoir surface at the top of the dam is 100 cfs.

2. Maximum Known Flood. The flood of record at Hartford, Connecticut occurred over a three-day period in August, 1955 when the primary spillway was overtopped by 3 feet. Since that time the spillway crest has been raised one foot.

3. Ungated Spillway Capacity at Top of Dam. The ungated spillway capacity at the top of dam Elevation 265.3, is 6,130 cfs.

4. Ungated Spillway Capacity at Test Flood Elevation. At test flood Elevation 264.8, the ungated spillway capacity is 5,440 cfs.

5. Gated Spillway Capacity at Normal Pool Elevation. Not Applicable.

6. Gated Spillway Capacity at Test Flood Elevation. Not Applicable.
 7. Total Spillway Capacity at Test Flood Elevation. See 4 above.
 8. Total Project Discharge at Top of Dam. The total project discharge at top of dam Elevation 265.3, including the outlet works, is 6,320 cfs.
 9. Total Project Discharge at Test Flood Elevation. The total project discharge at test flood Elevation 264.8, including outlet works, is 5,630 cfs.

c. Elevation. (NGVD)

Streambed at Toe of Dam	223.0
Bottom of Cutoff	Unknown
Maximum Tailwater	Unknown
Normal Pool	256.5
Full Flood Control Pool	NA
Spillway Crest (Gated)	NA
Spillway Crest (Primary)	256.5
Spillway Crest (Auxiliary)	261.9
Design Surcharge (Original Design)	Unknown
Top of Dam	265.3
Test Flood Surcharge	264.8

d. Reservoir Length. (Feet)

Normal Pool	1,880
Flood Control Pool	NA
Primary Spillway Crest Pool	1,880
Top of Dam Pool	1,940
Test Flood Pool	1,930

e. Storage. (Acre-Feet)

Normal Pool	284
Flood Control Pool	NA
Primary Spillway Crest Pool	284
Top of Dam Pool	619
Test Flood Pool	591

f. Reservoir Surface Area. (Acres)

Normal Pool	27
Flood Control Pool	NA
Primary Spillway Crest Pool	27
Top of Dam Pool	52
Test Flood Pool	51

g. Dam Data.

Type	Earth Embankment
Length	500 feet
Height	42 feet
Top Width	25 feet
Side Slopes (Upstream)	3H:1V
(Downstream)	2H:1V

Zoning	Unknown
Impervious Core	Unknown
Cutoff	Unknown
Grout Curtain	Unknown
h. <u>Diversion and Regulating Tunnel.</u>	None
i. <u>Spillways.</u>	
1. <u>Primary Spillway</u>	
Type	Overflow Drop Spillway
Length of Weir	45 feet
Crest Elevation	256.5
Gates	None
Upstream Channel	None
Downstream Channel	45-foot wide at headwall, narrows to 20 feet wide 300 feet downstream of headwall with stone lined side.
2. <u>Auxiliary Spillway</u>	
Type	Overflow Broad-Crested
Length of Weir	108 feet
Gates	None
Upstream Channel	None
Downstream Channel	Grass covered outlets into primary spillway downstream channel.
j. <u>Regulating Outlets.</u>	
1. <u>From Intake Tower</u>	
Invert Elevation	218 +
Size	(2) 24-inch diameter
Description	Cast Iron Pipe
Control Mechanism	Sluice gates in the intake Tower and gate valves in the gatehouse and gate chamber.
2. <u>From Intake Structure</u>	
Invert Elevation	250 +
Size	30-inch diameter
Description	Cast Iron Pipe
Control Mechanism	Gate Valve in the gate chamber

SECTION 2

ENGINEERING DATA

2.1 Design

According to Mr. Peter Revill, Chief Design Engineer for the Hartford Metropolitan District, none of the original design information with respect to the construction of Hartford Reservoir No. 1 dam (from 1864 to 1867) is available. Design information, for the primary and auxiliary spillway modifications made in 1967 and the water intake and toe drain system improvements of 1978 and 1979, is available from the Hartford Metropolitan District. Several of the available drawings have been reproduced and included in Appendix B.

2.2 Construction

Construction information exists for the primary and auxiliary spillway modifications made in 1967, the water intake improvements made in 1978 and the toe drain system which is still not completely installed in the downstream portion of the dam.

2.3 Operation

Normal operation of the dam consists of opening and closing valves in the downstream gate chamber, depending upon the availability of surplus water. If water is available, the appropriate valves are opened to direct the flow to the power generation facilities. If water is not available the valves are closed. In the event high inflow to the reservoir is anticipated valves are opened to permit discharge into Spice Brook to help lower the pool level.

2.4 Evaluation

a. Availability. Several drawings of Hartford Reservoir No. 1 Dam and related appurtenances and records of piezometer readings of groundwater levels from July, 1977 to December, 1977 are available from the Hartford Metropolitan District. Many of the drawings and related data have been included, at least in part, in Appendix B.

b. Adequacy. Sufficient information has been obtained during the field investigation, from the available drawings and data, and through subsequent telephone conversations with Metropolitan District personnel, to conduct a Phase I dam evaluation.

c. Validity. Other than the 2.1-foot elevation difference between Hartford Metropolitan District datum and NGVD, it appears that the information obtained from the Metropolitan District is valid.

SECTION 3
VISUAL INSPECTION

3.1 Findings

a. General. Hartford Reservoir No. 1 Dam was inspected on November 13, 1979. At the time of inspection, the reservoir level was approximately 1.5 feet below the crest of the primary spillway. Underwater areas were not inspected.

A checklist of observations and comments made during the field inspection is included as Appendix A of this report.

b. Dam. The dam, which appears to be in fair condition, is approximately 500 feet long with a maximum height of 42 feet. The following features were noted during the field inspection:

1. The upstream face of the embankment is grass-covered with some riprap protection on the lower portion of the slope. The riprap extends from an elevation approximately 3 feet above the observed pool level to an undetermined depth below the water surface. Several small bushes were observed growing along the top edge of the riprap portion of the slope. Some riprap stone is missing on the upstream face of the dam.

2. The crest of the dam is approximately 25 feet wide and, at the time of the inspection, was 10.3 feet above the reservoir surface. A 14-foot wide paved access road along the crest of the dam appears to be in good condition. Rows of shrubbery line each side of the roadway.

3. The downstream face of the embankment is grass-covered; however, the following deficiencies were noted during the inspection: a) A permanently saturated condition at the downstream toe; b) Several evergreen trees were observed in the vicinity of the abutments and at the toe of the slope in the vicinity of the gate house; c) Animal burrows were observed in the downstream embankment face; d) An undulated area at the downstream toe of the slope near the gate house was observed. It could not be determined if the irregularities at the downstream toe of the slope were caused by embankment movement or the recent installation of a toe drain system; and e) a depression in the downstream slope, which extends from the crest of the dam to the toe and parallels the alignment of the outlet pipes through the embankment, was observed.

Several photos of the dam have been included in Appendix C.

c. Appurtenant Structures. The primary and auxiliary spillways appeared to be in good condition on the date of the inspection. The intake tower, the access bridge, the intake structure and the downstream gate house appear to be well maintained and in good condition. Some minor spalling was noted on the gate house near the water surface. The gate valves inside these structures were not inspected; however, Metropolitan District personnel said they are operable. The gate chamber and the gate valves at the downstream power house also appeared to be in good condition at the time of inspection. Drawings and photos of the primary and auxiliary spillways, the intake tower, the downstream gate house, the intake structure, the gate chamber and the power generation building are included in Appendix B and Appendix C, respectively.

d. Reservoir Area. The terrain along the perimeter of the pond is well vegetated and appears to be stable and free of erosion. The slope of the terrain around the pond varies from 2 percent to 25 percent.

e. Downstream Channel. Water discharging from the power generation building or through the low level outlet enters Spice Brook. The Brook flows through a well defined natural stream channel which is relatively clear of major obstructions. Spice Brook discharges into Trout Brook an estimated 4,000 feet downstream from the dam.

3.2 Evaluation. The deficiencies noted during inspection of the dam were the permanently saturated condition at the downstream toe (apparently due to seepage through the embankment) which has been partially corrected with the installation of a portion of the toe drain system, the disturbed area at the toe of the downstream face of the dam and the depression in the downstream face of the dam. The disturbance at the toe was most likely created during installation of the toe drains in 1978 and should be renovated as recommended in Section 7. The depression is probably the result of improper compaction around the outlet pipes.

Other observed deficiencies include evergreen trees growing in the vicinity of the abutments on the downstream face of the dam and in the vicinity of the downstream toe of the dam. Some riprap stone is missing on the upstream face of the dam and brush was observed growing from between riprap stones. Animal burrows were noted in the downstream embankment face. These conditions should also be improved as recommended in Section 7.

SECTION 4

OPERATION AND MAINTENANCE PROCEDURES

4.1 Operational Procedures

a. General. According to Mr. Allen, the primary function of Hartford Reservoir No. 1 is to impound water for the power generation facilities located about 100 feet downstream of the dam. Normal operation consists of discharging water through the power generation building when surplus water is available. Generally, water is available for power generation between 40 and 60 percent of the year.

Three sets of gates control low level discharges from the reservoir. An intake tower is located in the reservoir near the center of the dam. The operator may control the pool level from this structure by operating the appropriate sluice gates. However, the valves on the low level discharge pipes in the downstream gatehouse must also be opened for discharge to occur. Still further downstream, valves may be operated at a gate chamber to direct the flow either to the power generation facilities or to Spice Brook. The gates in the intake tower are normally closed so that the pipes through the embankment are not under pressure.

b. Description of Any Warning System in Effect. Currently, there is no formal warning system in effect. According to the Owner's representative, Mr. Peter Revill, the Labor Foreman will monitor reservoir levels during periods of unusually heavy runoff and/or rainfall.

4.2 Maintenance Procedures

a. General. The Metropolitan District employs a maintenance crew, headed by Mr. Rudy Wegscherder, who operates and maintains the West Hartford reservoir system. Maintenance of the dams and grounds is performed on a routine basis.

In 1972, the Metropolitan District installed three piezometers at the toe of the downstream slope to monitor groundwater levels. The owner had become aware that the downstream toe was constantly saturated and the piezometers were installed to assess the need for a toe drain. Records of groundwater levels were kept from July, 1977 to December, 1977 and are available from the Metropolitan District. Based upon an analysis of the data collected during this 6-month period, it was decided that a toe drain could alleviate the seepage problem. A toe drain was designed and, at the time of the inspection, approximately half of the proposed system had been installed.

b. Operating Facilities. According to the Owner's representative, valves and sluice gates controlling discharge from Reservoir No. 1 are kept in good operating condition and are serviced as required.

4.3 Evaluation

The current operation and maintenance program appears to be good with the following exceptions:

1. Growth of large trees on the dam, or any other type of vegetation with an extensive root system, should not be permitted. In addition, any growth which prohibits good visibility of the slope should be removed from the dam.
2. Animal burrow holes, observed on the downstream face of the dam, should be properly backfilled.
3. All surfaces of the dam should be kept in good condition. In particular, the rough area at the toe of the downstream slope should be re-graded and seeded.

SECTION 5

EVALUATION OF HYDRAULIC/HYDROLOGIC FEATURES

5.1 General

The drainage area for Hartford Reservoir No. 1 Dam encompasses 3.9 square miles which are mostly forested. The local drainage area (excluding the area drained by the other Hartford Reservoirs) is approximately 2.2 square miles. However, South Flood Control Dam drains 1.3 square miles of this local drainage area, limiting the direct runoff area for Hartford Reservoir No. 1 to 0.9 square miles. Hydraulic information for South Flood Control Dam is included in Appendix D. The normal water surface area of Hartford Reservoirs 1, 2, 3 and 5 accounts for an estimated 6 percent of the total drainage area.

The portion of the watershed draining to Reservoirs 2, 3, and 5 is undeveloped and almost entirely forested. The only development within the entire drainage basin is located 0.5 to 1.0 miles to the southwest of Reservoir No. 1 in an area called Oakland Gardens.

The topography is predominantly mountainous, ranging in elevation from 800 along the Talcott Mountain range to 256.5 at the normal reservoir surface of Hartford Reservoir No. 1.

5.2 Design Data

According to the Owner's representative, hydraulic and hydrologic data used for the original design of the Hartford Reservoir No. 1 Dam, is not available. The design of the auxiliary spillway, built in 1967, was based upon the peak runoff anticipated during a 34-hour, 18.25-inch rainfall.

5.3 Experience Data

The flood of record in Hartford occurred in August, 1955, as a result of rain which fell over a three day period during Hurricane Diane.

The maximum water surface observed at Reservoir No. 1 was approximately three feet above the primary spillway crest. Since that time the primary spillway crest has been raised one foot.

5.4 Test Flood Analysis

The recommended test flood for an "Intermediate" size, "High" hazard dam is the full Probable Maximum Flood (PMF).

Hydraulic and hydrologic calculations were performed with the assistance of the HEC-1-DB computer program. The flood hydrographs were constructed from Snyder unit hydrographs using average coefficients, an initial infiltration of zero and a constant loss rate of 0.05 inches per hour. The Hop Brook Adjustment Factor was used to reduce the Probable Maximum Precipitation based upon the size of the drainage area.

Stage-discharge and stage-storage relationships were developed for each of the upstream reservoirs and input into the computer for the purpose of routing the test flood to Hartford Reservoir No. 1 Dam. Water surface elevations at all upstream reservoirs were assumed to be at their respective spillway crests at the beginning of the hypothetical storm event.

The peak inflow and outflow rates for the test flood at Hartford Reservoir No. 1 Dam were computed to be 5,590 cfs and 5,440 cfs, respectively. The peak outflow corresponds to a reservoir stage of 8.3 feet above the primary spillway crest (0.5 feet below the top of the dam). The spillway system is capable of discharging 100 percent of the routed test flood outflow.

5.5 Dam Failure Analysis

Failure of the dam at Hartford Reservoir No. 1 was simulated through the use of the HEC-1-DB computer program, assuming that a 300-foot wide and 35.3-foot deep breach with vertical side slopes would develop within 2 hours from the start of the failure. Failure was assumed to occur with the pool level at the test flood elevation in the first case and at the spillway crest for the second case. The resulting outflow for each case was routed to the first major residential damage center, located approximately 2,000 feet downstream of the dam at the point where Spice Brook flows under Old Mill Lane. The flow at the damage center immediately prior to failure of the embankment was computed by routing the test flood spillway discharge to the hazard center for the reservoir at test flood elevation case and was assumed to be equivalent to the flow observed during the visual inspection for the reservoir at spillway crest case. These flows were compared to the breach flows to assess the increase in hazard caused by a failure of the embankment. Refer to Appendix D for the assumed channel cross-section at this point.

The failure analysis indicated that a breaching of the dam with the reservoir surface at the top of the dam would result in a stream depth of 7.7 feet, or 5.7 feet above the channel banks, with a corresponding flow of 6,000 cfs at the damage area. The estimated sill elevation of the lowest houses in this area is 2 feet above the channel banks. Therefore, the breach flood would inundate the house with 3.7 feet of water causing excessive property damage and the possible loss of more than a few lives. With the reservoir surface at the spillway crest, a breach flood would result in a stream depth of 6.8 feet and a corresponding flow of 4,480 cfs. This flood would also cause excessive property damage and the possible loss of more than a few lives.

The stream depth and quantity of flow at the hazard center immediately prior to failure of the dam were computed to be 5.7 feet and 3,070 cfs, respectively, with the reservoir surface at the test flood elevation. A stream depth of 0.5 feet and flow of 35 cfs were estimated with the reservoir surface at the spillway crest. Therefore, a dam breach would result in a significant increase in hazard to loss of life downstream.

The initial damage center is the Metropolitan District power generating facilities 100 feet downstream of the dam. These facilities would probably be destroyed by floodwaters resulting from a dam failure.

SECTION 6

EVALUATION OF STRUCTURAL STABILITY

6.1 Visual Observations

A permanently saturated condition exists at the downstream toe which has been partially corrected with the installation of a portion of the toe drain system. An undulated area was observed at the downstream toe of the dam, near the location where toe drains were installed in 1978. It could not be determined if the area was undulated as a result of the toe drain installation or because of embankment displacement. A depression of the downstream face which follows the alignment of the outlet pipes and extends from the crest to the toe of the dam was also observed during the inspection. This depression appears to be a result of improper compaction around the outlet pipes. However, seepage could have been a contributing factor.

Several other deficiencies which were observed during the inspection, such as trees growing on the downstream face of the dam near the abutments and near the downstream toe, riprap displacement on the upstream face, and animal burrow holes on the downstream face, could lead to structural damage if they are not removed and/or repaired.

No other indications of structural deficiency were observed. Photos of the dam are included in Appendix C.

6.2 Design and Construction Data

According to the Owner's representative, no data with regard to the original design and construction of the dam at Hartford Reservoir No. 1 is available.

6.3 Post Construction Changes

Since the original construction of the dam between 1864 and 1867, there have been three major construction changes: 1) According to Metropolitan District records, the dam was rebuilt in 1868; 2) Power generation facilities (and presumably the 30-inch transfer pipe) were constructed in 1922; and 3) The auxiliary spillway was built and the primary spillway was raised one foot in 1967. In addition, recent modifications to the dam include the installation of a toe drain (construction not yet completed) and reconstruction of the intake structure on the 30-inch transfer pipe which carries water to the power generation facilities.

6.4 Seismic Stability

Hartford Reservoir No. 1 Dam is located in Seismic Zone 1 on the Seismic Zone Map of Contiguous States. A dam located in Seismic Zone 1 need not be evaluated for seismic stability, according to the Recommended Guidelines for Phase I Dam Inspections.

SECTION 7

ASSESSMENT, RECOMMENDATIONS & REMEDIAL MEASURES

7.1 Dam Assessment

a. Condition. The dam appears to be in fair condition. The Owner has been cognizant of a seepage problem at the site for at least 3 years because of the permanently saturated conditions observed at the toe of the dam. This condition was observed during the inspection of the site but, because of the installation of the drains in 1978, the situation has improved, but still exists. Additional drain installation work is planned. The undulated area at the downstream toe of the dam, where the toe drains were installed in 1978, could be the result of the toe drain installation or embankment displacement. The depression on the downstream face of the dam which follows the alignment of the outlet pipes and extends from the crest of the dam to the toe could be the result of improper compaction or seepage around the outlet pipes.

Other deficiencies include trees growing on the downstream face of the dam, near the abutments and near the downstream toe, riprap displacement on the upstream face and animal burrows in the downstream face.

Recommendations and operation and maintenance measures which should be implemented are discussed in Sections 7.2 and 7.3.

b. Adequacy of Information. Sufficient information has been obtained through field observations, from data supplied by the Metropolitan District and through subsequent telephone conversations with Metropolitan District personnel to conduct a Phase I dam evaluation.

c. Urgency. The recommendations and remedial measures presented in this Section should be implemented within one year of receipt of this Phase I Inspection Report.

7.2 Recommendations

It is recommended that the Owner retain a qualified registered professional engineer, experienced in the design and construction of dams, to direct the removal of the trees in the vicinity of the abutments and at the toe of the downstream face of the dam. Voids left in the embankment by the removal of the trees should be filled with suitable, thoroughly compacted material.

7.3 Remedial Measures

a. Operation and Maintenance Procedures. The Owner should implement the following operation and maintenance measures:

1. The toe drain construction should be completed.

2. The area at the downstream toe of the dam, in the vicinity of the new toe drain installation, should be regraded, seeded and monitored for future movements.
3. The depression in the downstream face should also be regraded, reseeded, and monitored for future settlement.
4. Extraneous vegetation should be removed from the riprapped portion of the upstream face of the dam and riprap should be replaced where necessary.
5. Animal burrows, in the downstream face of the dam, should be backfilled to eliminate possible seepage paths.
6. A formal surveillance and flood warning plan should be developed.
7. A program of periodic annual technical inspection should be instituted.

7.4 Alternatives

No valid alternatives to the recommendations described above are considered feasible for this site.

APPENDIX A

INSPECTION CHECKLIST

VISUAL INSPECTION CHECK LIST

INSPECTION TEAM ORGANIZATION

Project: Hartford Reservoir No 1 Dam

National I.D. #: CT 00001

Location: Hartford, Connecticut

Type of Dam: Earth Embankment

Inspection Date(s): November 13, 1979

Weather: Overcast, Mid 50's

Pool Elevation: 256.5 ± MSL

Inspection Team

Leonard Beck	O'Brien & Gere	Structures
Steven Snider	O'Brien & Gere	Foundations & Materials
Alan Hanscom	O'Brien & Gere	Structures
Rodney Georges	Bryant & Associates	Hydrology/Hydraulics

*Mr. John J. Williams, Vice-President, O'Brien & Gere has visited the site but not necessarily in conjunction with the inspection team.

Owner's Representative

Mr. Peter Revill, Chief Design Engineer;

Metropolitan District, 555 Main Street;

P.O. Box 800 ; Hartford, Conn. ; 06100

VISUAL INSPECTION CHECK LIST

Project: Harcourt Reservoir No. 1 Dam
 National I.D. #: CT 00001
 Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
<u>DAM EMBANKMENT</u>	
Crest Elevation	265.3 ±
Current Pool Elevation	256.5 ±
Maximum Impoundment to Date	1955 - Main Spillway overtop by 3 feet ~ 360 ac-ft
Surface Cracks	None Observed
Pavement Condition	Very Good
Movement or Settlement of Crest	None Observed
Lateral Movement	None Observed
Vertical Alignment	No Misalignment Observed
Horizontal Alignment	" " "
Condition at Abutment and at Concrete Structures	Large Evergreen Trees @ Each Abutment downstream face
Indications of Movements of Structural Items on Slopes	None Observed
Trespassing on Slopes	Negligible
Vegetation on Slopes	Some weeds, slight brush growth on u/s face
Sloughing or Erosion of Slopes or Abutments	Sloughing @ d/s toe - Apparently caused by toe drain installation - '78
Rock Slope Protection - Riprap Failures	Some misalignment u/s face

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 1 DamNational I.D. #: CT 00001Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
<u>DAM EMBANKMENT (Con't)</u>	
Unusual Movement or Cracking at or near Toes	Rough area & wet to the SE of lower gate house.
Unusual Embankment or Downstream Seepage	No flowing seepage observed - saturated @ d.s. toe
Piping or Boils	None observed
Foundation Drainage Features	Unknown
Toe Drains	Half of proposed toe drains installed - see Appendix B
Instrumentation System	None
Miscellaneous	Few Animal Burrows & Trees @ Toe of d/s slope (See photos)

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 1 DamNational I.D. #: CT 00001Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS</u>	
a. Approach Channel	
General Condition	<i>NA</i>
Loose Rock Overhanging Channel	"
Trees Overhanging Channel	"
Floor of Approach Channel	"
b. Weir and Training Walls	
General Condition of Concrete	<i>Very Good</i>
Rust or Staining	<i>None Observed</i>
Spalling	<i>Slight</i>
Any Visible Reinforcing	<i>No</i>
Any Seepage or Efflorescence	<i>None Observed</i>
Drain Holes	<i>None</i>
c. Discharge Channel	
General Condition	<i>Clear of major obstructions Dry - seldom used</i>

VISUAL INSPECTION CHECK LIST

Project: Hazardous Precipice No. 1 DamNational I.D. #: CT 00001Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - SPILLWAY WEIR, APPROACH AND DISCHARGE CHANNELS (Con't)</u>	
Loose Rock Overhanging Channel	Few - along small stone walls on each side of channel
Trees Overhanging Channel	None observed
Floor of Channel	Fairly smooth - mostly dry
Other Obstructions	Fallen tree @ nearly d/s bridge

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 1 DamNational I.D. #: CT 00001Date(s): November 13, 1980

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - CONTROL TOWER</u>	
a. Concrete and Structural	
General Condition	Good
Condition of Joints	Good
Spalling	Slight - near pool elev.
Visible Reinforcing	None
Rusting or Staining of Concrete	None observed
Any Seepage or Efflorescence	None observed
Joint Alignment	Very Good
Unusual Seepage or Leaks in Gate Chamber	None observed
Cracks	Superficial cracking
Rusting or Corrosion of Steel	None
b. Mechanical and Electrical	
Air Vents	E side of Tower
Float Wells	NA
Crane Hoist	NA

VISUAL INSPECTION CHECK LIST

Project: Hartford Reservoir No. 1 DamNational I.D. #: CT 00001Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - CONTROL TOWER (Con't)</u>	
Elevator	NA
Hydraulic System	NA
Service Gates	Good Operating Condition
Emergency Gates	" " "
Lighting Protection System	Unknown
Emergency Power System	None
Wiring and Lighting System in Gate Chamber	Good Condition
Miscellaneous	Tower - very well maintained

VISUAL INSPECTION CHECK LIST

Project: Harcourt Reservoir No. 1 DamNational I.D. #: OT 00001Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - INTAKE CHANNEL AND INTAKE STRUCTURE</u>	(Intake for power facility)
a. Approach Channel	
Slope Conditions	Training walls - submerged
Bottom Conditions	Submerged
Rock Slides or Falls	None observed
Log Boom	None
Debris	Large tree stump
Condition of Concrete Lining	Unknown
Drains or Weep Holes	None observed
b. Intake Structure	
Condition of Concrete	New
Stop Logs and Slots	No stop logs - only trash rack & screens

VISUAL INSPECTION CHECK LIST

Project: Hartland Reservoir No. 1 DamNational I.D. #: CT 00001Date(s): November 13, 1979

AREA EVALUATED	CONDITIONS
<u>OUTLET WORKS - OUTLET STRUCTURE AND OUTLET CHANNEL</u>	(Power Facility)
General Condition of Concrete	Good
Rust or Staining	② outlet drain (d/s side)
Spalling	slight
Erosion or Cavitation	No significant erosion
Visible Reinforcing	None
Any Seepage or Efflorescence	None observed
Condition at Joints	Very Good
Drain Holes	Roof drains - d/s side
Channel	Spice Brook - good
Loose Rock or Trees Overhanging Channel	Several at each
Condition of Discharge Channel	Generally clear, but small

APPENDIX B

ENGINEERING DATA



O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT

HARTFORD RESERVOIR #1 DAM

SHEET

BY

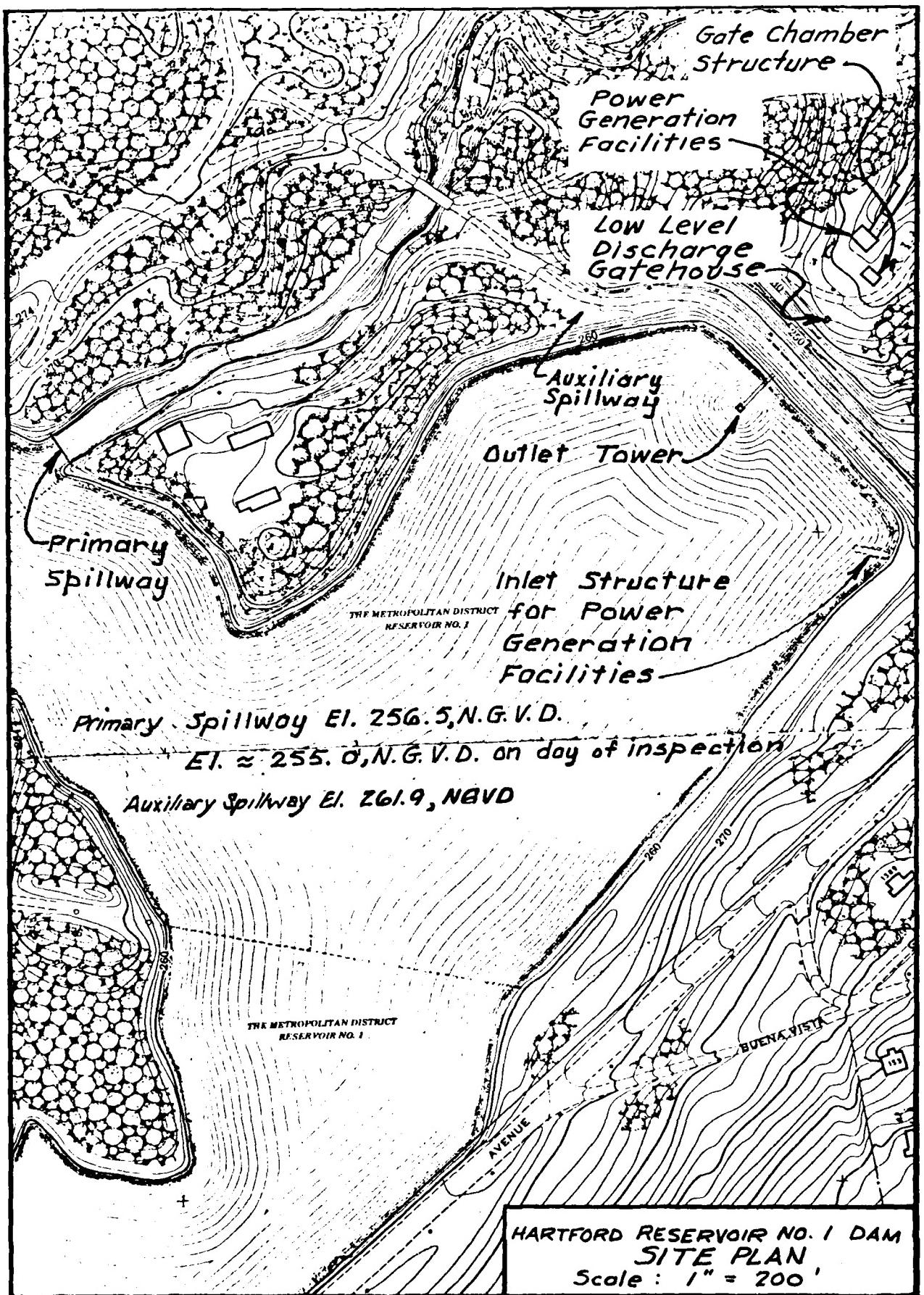
DATE

JOB NO

APPENDIX B
ENGINEERING DATA
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NOTE: INFORMATION INCLUDED IN THIS APPENDIX WAS
OBTAINED FROM THE HARTFORD METROPOLITAN
DISTRICT. UNLESS OTHERWISE NOTED, ELEVATIONS
REFER TO METROPOLITAN DISTRICT DATUM.

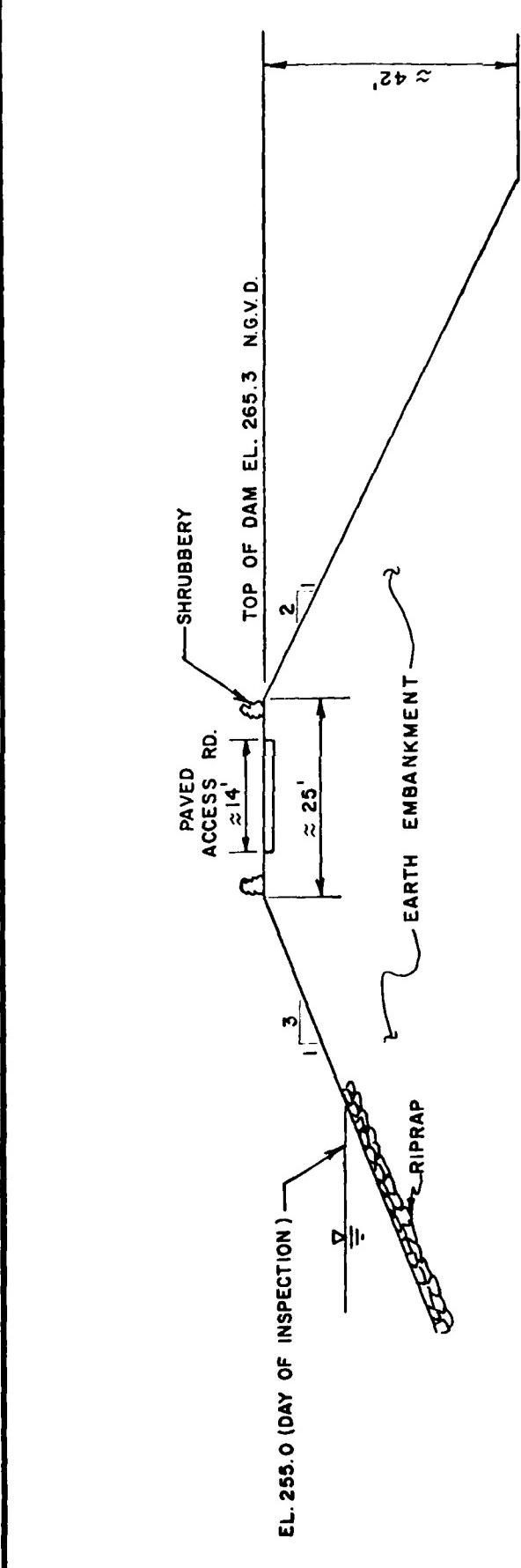


B-1

HARTFORD RESERVOIR - NO. I DAM
DOWNSTREAM TOPOGRAPHY OF DAM

CREST OF DAM EL. 265.3 NG.V.D.

LOW LEVEL DISCHARGE
GATEHOUSE



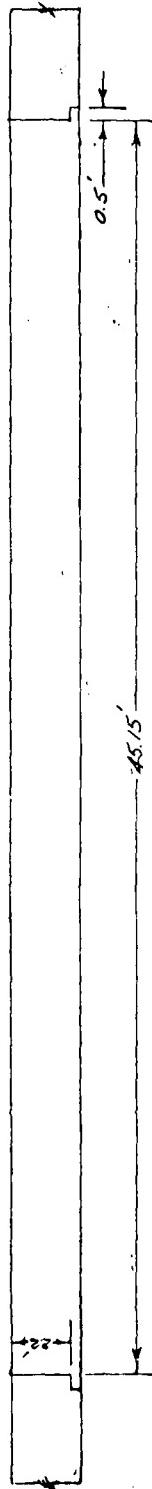
TYPICAL DAM SECTION

SCALE: NONE

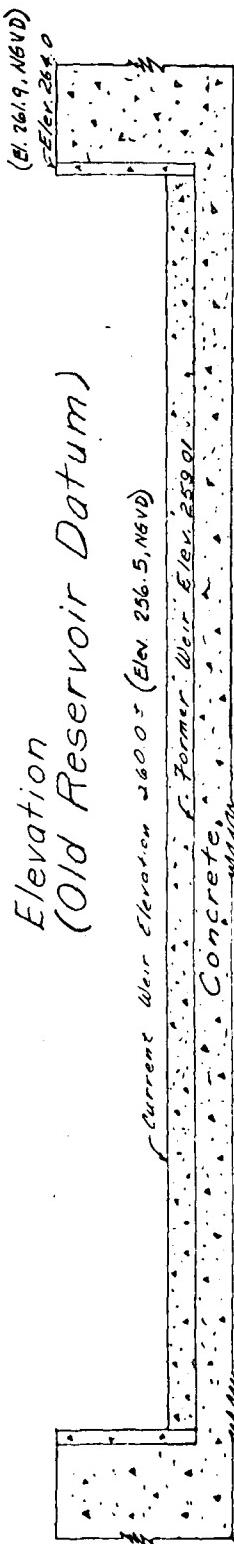
NOTE: ALL DIMENSIONS ARE APPROXIMATE.

HARTFORD RESERVOIR NO. I DAM

*Plan View of Overflow Weir
Reservoir No. 1*



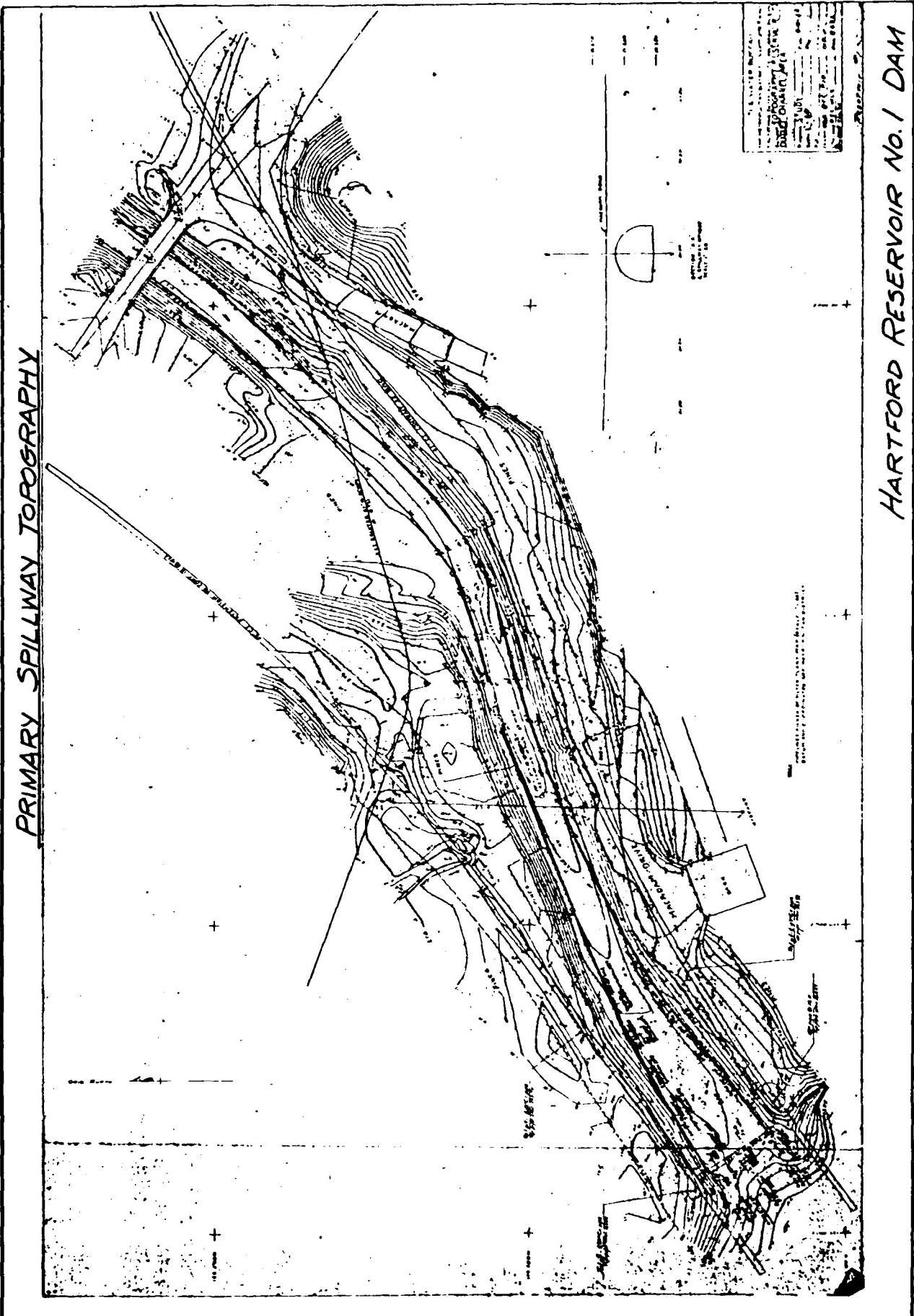
*Elevation
(Old Reservoir Datum)*



*Side Elevation - Overflow Weir
Reservoir No. 1*

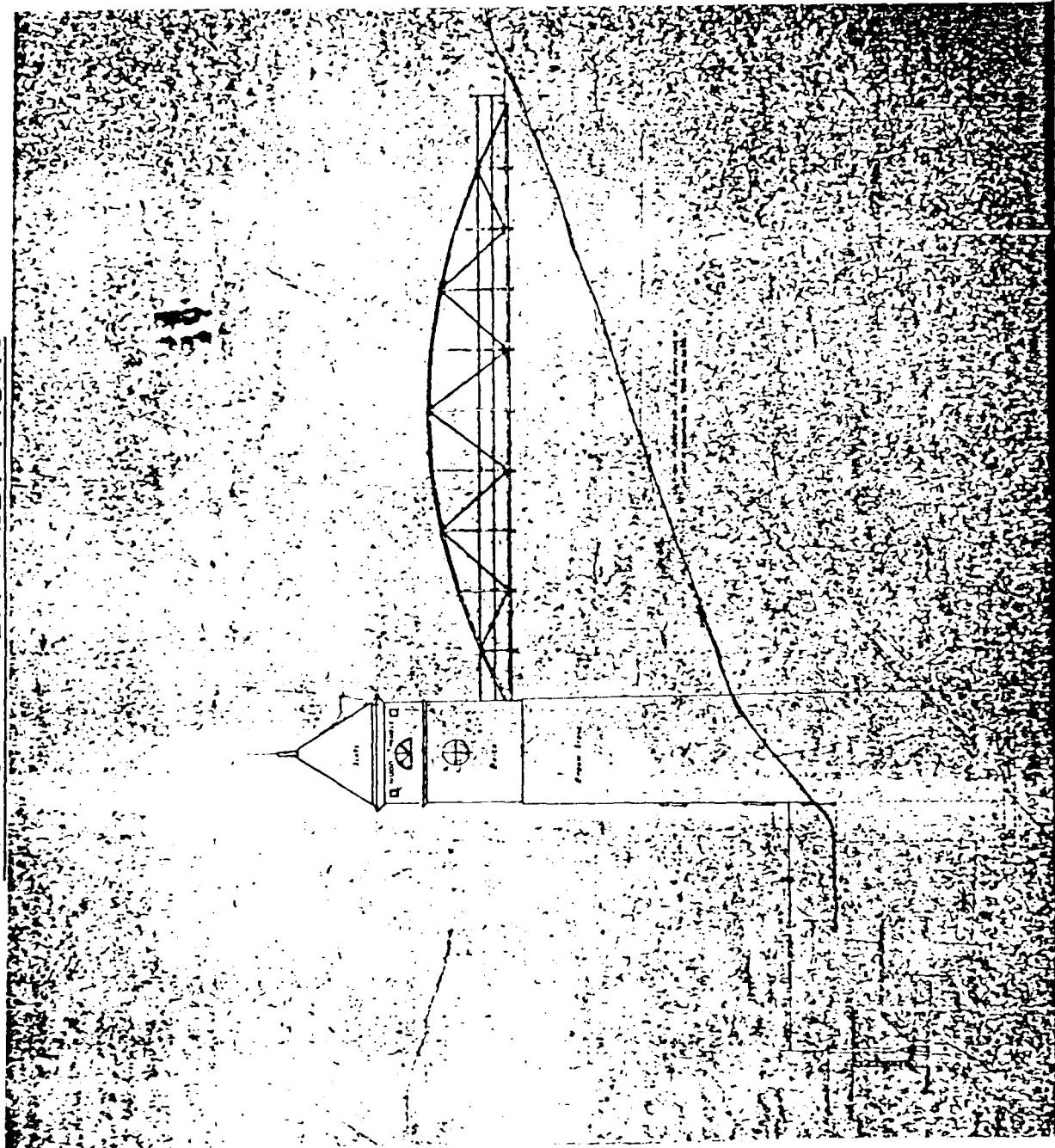
**HARTFORD RESERVOIR NO. 1 DAM
PRIMARY SPILLWAY PLAN & ELEVATION**
SCALE: NONE

PRIMARY SPILLWAY TROPOGRAPHY



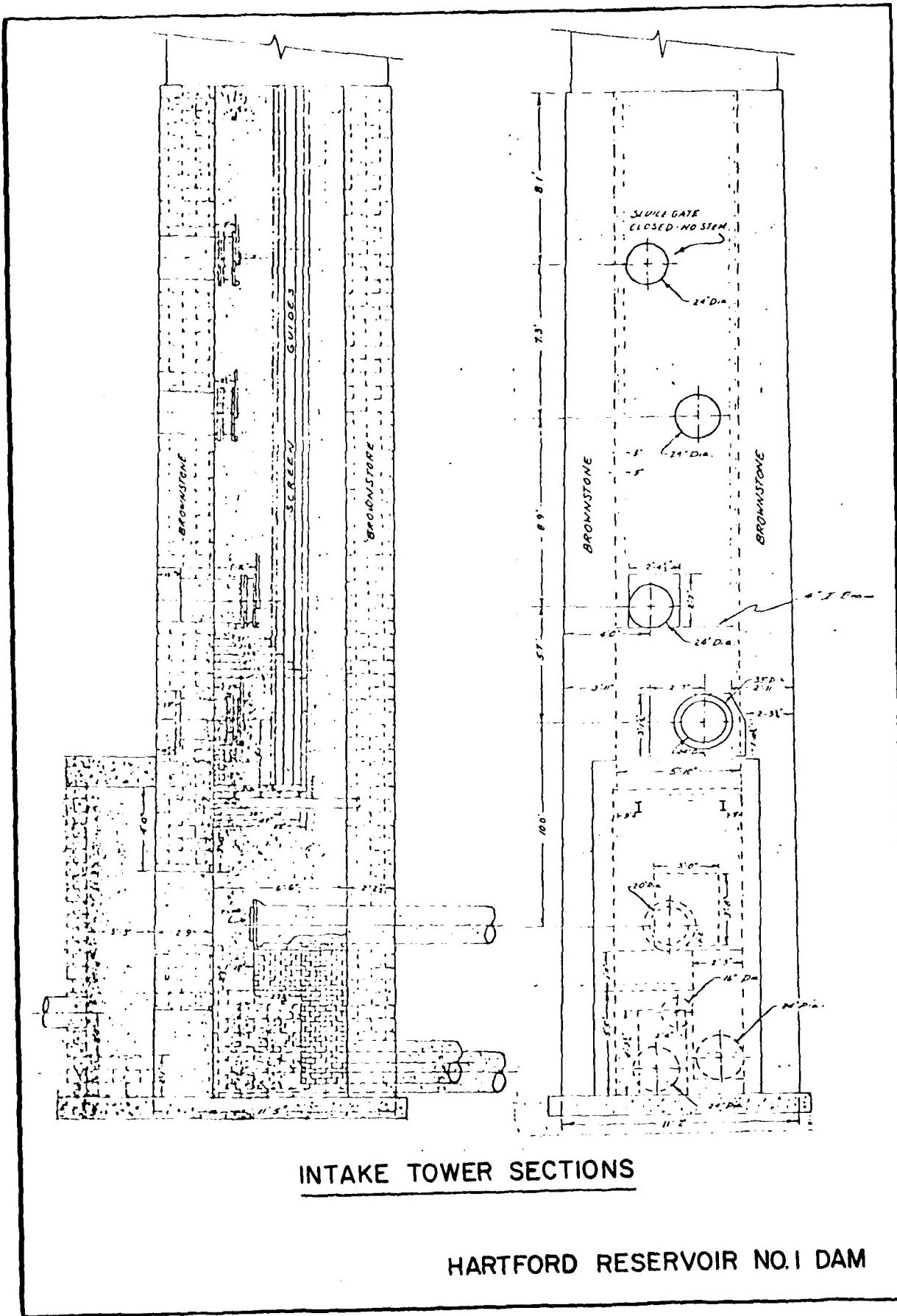
B-5

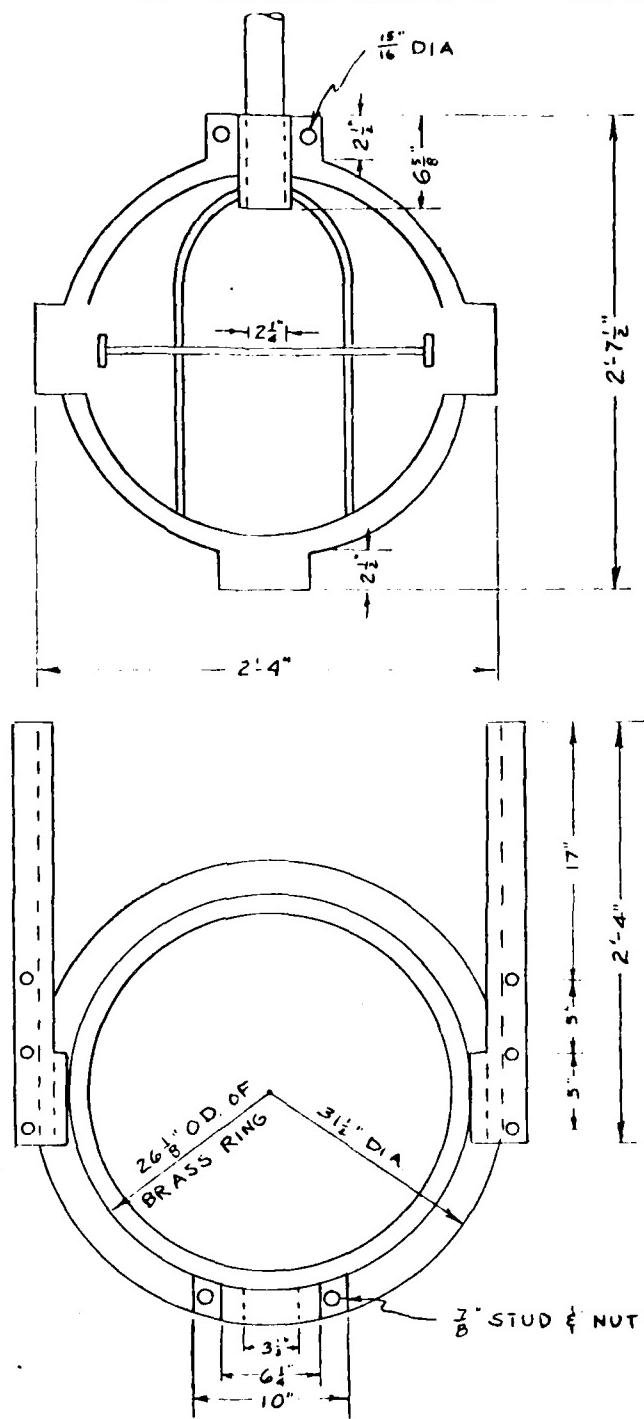
INTAKE TOWER ELEVATIONS



HARTFORD RESERVOIR NO. 1 DAM

B-6

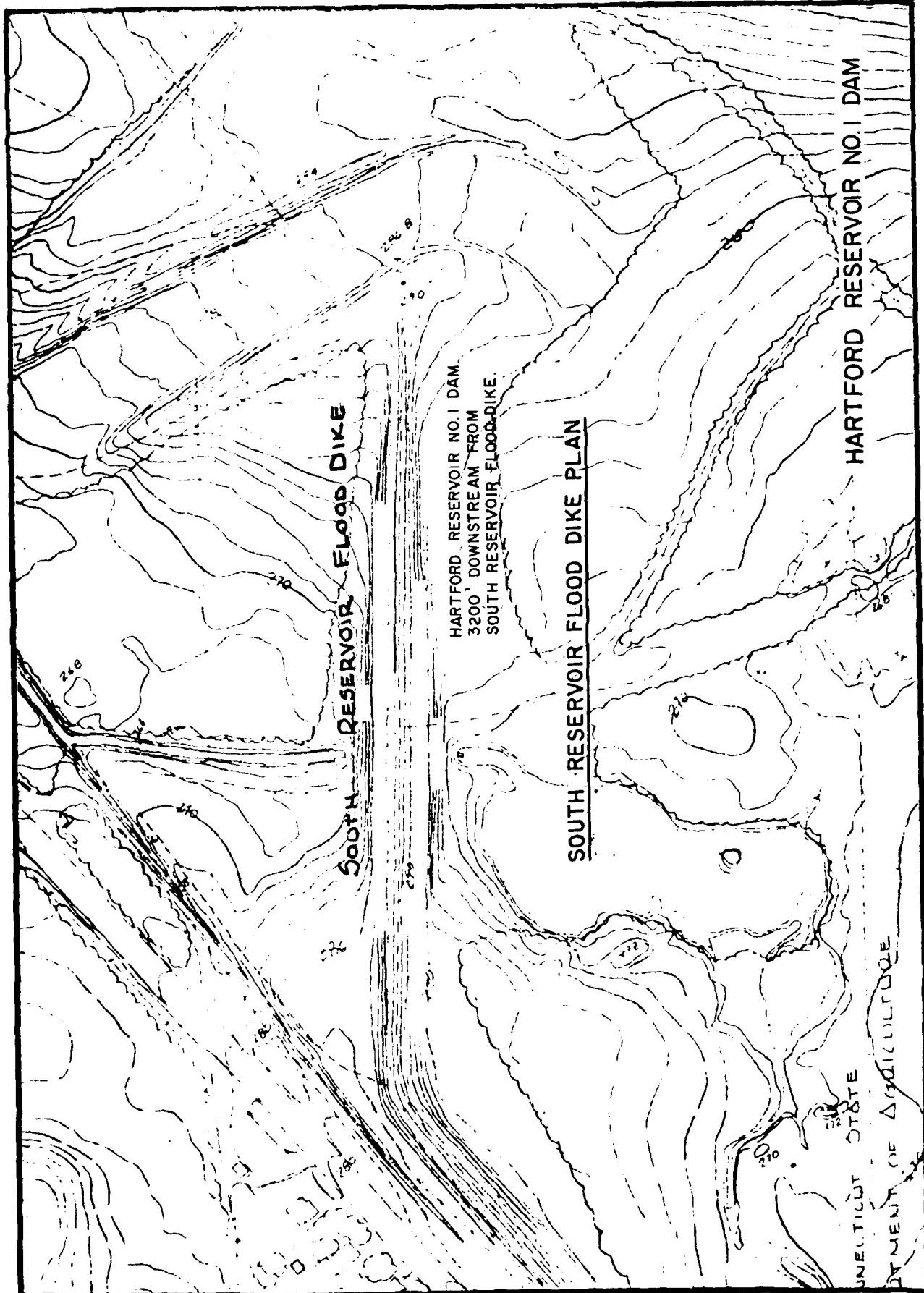




INTAKE TOWER SLUICE GATE DETAILS

HARTFORD RESERVOIR NO. I DAM

B-8



PROJECT	SHEET	BY	DATE	JOB NO
NE DAM INSPECTIONS	1/2			2060.001

HARTFORD RESERVOIRS 1,3 & 5

PERTINENT DATA

HARTFORD RESERVOIR NO :

1	3	5
---	---	---

I. GENERAL :

Main River	Trout Brook & S. Branch Park River		
Use	Power pond Waste Pool	Reserve Water Supply	Water Supply Balancing
When Built	1864 - 1867 Rebuilt 1868	1875	1884
Comments	Improved 1967	Improved 1964	Improved 1964

II. ELEVATIONS & DATUMS :

USGS Flow Line	256.5'	391.2'	319.7'
MDC: Flow Line	258.6'	393.3'	321.8'
Const: Flow Line	259.0'	393.7'	322.3'
Const.: Bottom	225.0'	357.0'	303.0'

III. CAPACITY (MG) :

Available for Stated use	13.2	96	68
Below Avail Level	5.5	50	15

IV. MISCELLANEOUS :

Flow Line Area (Ac)	27	28	25
Maximum Depth (ft.)	34	36	19
Watershed Area (m^2)	4.3	0.6	1.4

B-10

SUBJECT	NE DAM INSPECTIONS	SHEET 2/2	BY	DATE	JOB NO 2060.001
---------	--------------------	--------------	----	------	--------------------

HARTFORD RESERVOIRS 1, 3 & 5

PERTINENT DATA (Cont.)

HARTFORD RESERVOIR NO.:

1	3	5
---	---	---

IV. MISCELLANEOUS (CONT.)

Ave. Annual Rainfall	44.3" (61.4" Max. & 28.9 Min.)
Ave. Annual Runoff	NA 1.9 Billion Gallons
Design Fld. Runoff	1964 improvements: 18 1/4 " in 34 hours

V. SPILLWAY INFORMATION:

Length (feet)	45	23	62
Design Flow Head (feet)	8.3*	3.9*	2.5
Design Flow (cfs)	4,000*	400*	700
Freeboard Above Crest (feet)	8.8	5.2	5.2

* With Emergency Spillway.

STATE OF CONNECTICUT
WATER RESOURCES COMMISSION
State Office Building
Hartford, Connecticut

CONSTRUCTION OF EMERGENCY SPILLWAY ON HARTFORD RES. 1 DAM
APPLICATION FOR CONSTRUCTION PERMIT FOR DAM

Owner The Metropolitan District

Date January, 1967

P.O. Address 115 Broad Street

Hartford, Connecticut 06105

Tel. No. 525-0841

Location of Structure:

Town West Hartford Shown on USGS Quadrangle Avon

Name of Stream Reservoir No. 1 at 0 inches south of Lat. 41°-45'
north
and 0 inches east of Long. 72°-47'
west

Directions for reaching site from nearest village or route intersection:
(see sketch on reverse side)

See locality Plan attached

Construction of an emergency spillway on an existing reservoir.

This is an application for: (New Construction) (Alteration) (Repair) (Removal)
(check one or more of above)

This pond is ~~presently used for~~ intermittent generation of electric power.

Dimensions of Pond: width 600'± length 1,800' area 25± acres

Maximum depth of water immediately above dam: 33'±

Total length of dam: 600'±

Length of spillway: 45' (principal spillway)

Height of abutments above spillway: 5.0' (8.8' freeboard on dam)

Type of spillway construction: Concrete

Type of dike construction: _____

Spillway section will be set on: (Bedrock) (Gravel) (Clay) (Till)
(check one of above)

Remarks: Attached are a statement of purpose, presentation plans and statistics, and proposed contract and construction drawings.

Signed: The Metropolitan District
(owner)

Name of Engineer, if any G. U. Gustafson,

Note: Show details of construction on reverse side

Deputy Manager for Engineering

B-12

With Bureau of the
Metropolitan District
1964

PROPOSED HYDROLOGIC IMPROVEMENTS
TO THE WEST HARTFORD RESERVOIRS
TABLE OF FINAL STATISTICS

H-3546-A
June 1964

RESERVOIR STATISTICS	Unit Watershed	Res. No. 6	Res. No. 2	Res. No. 5	Res. No. 3	Res. No. 1
Independent Watershed Area	1.00 Sq. mi.	2.00 Sq.mi.	0.65 Sq.mi.	0.30 Sq.mi.	0.60 Sq.mi.	1.00 Sq.mi.
Receives Spillway Discharge from Upstream Reservoirs as Noted	—	None	Talcott(SCS)	No. 2	None	No. 5 & South(SCS)
Proposed Level of Top of Dams & Dikes	—	EI. 407.5	EI. 392.0	EI. 327.0	EI. 398.5	— \$
Proposed Spillway Crest Level	—	EI. 400.6	EI. 387.6	EI. 321.8	EI. 393.5*	— \$
Surcharge Storage - Acrefeet / foot	—	135	42	24	24	26
<u>PROJECT STORM</u>						
Total Rainfall	18.24"					
Storm Duration	34 hrs					
Maximum One-Hour Rainfall	1.61 "					
Maximum Run-Off Rate (Independent area)	900 cfs	1,880 cfs	590 cfs	270 cfs	520 cfs	900 cfs
Maximum Inflow Rate		1,880 cfs	620 cfs	690 cfs	520 cfs	1,960 cfs
Maximum Reservoir Level		EI. 404.2	EI. 389.6	EI. 324.3	EI. 397.2*	— \$
Maximum Discharge Rate		1,080 cfs	490 cfs	670 cfs	420 cfs*	— \$
<u>EMERGENCY STORM</u>						
Total Rainfall	18.24"					
Storm Duration	24 hrs					
Maximum One-Hour Rainfall	6.35 "					
Maximum Run-Off Rate (Independent area)	2,900 cfs	5,960 cfs	1,930 cfs	880 cfs	1,730 cfs	2,570 cfs
Maximum Inflow Rate		5,960 cfs	1,980 cfs	2,110 cfs	1,730 cfs	6,190 cfs
Maximum Reservoir Level		EI. 407.0	EI. 391.6	EI. 326.5	EI. 398.1*	— \$
Maximum Discharge Rate		1,460 cfs	1,300 cfs	1,770 cfs	1,730 cfs*	— \$

Note: All elevations are referred to Met. Dist. Datum.
(SCS) Indicates Flood Detention Reservoirs

presently being built by the Soil Conservation Service.

* Reservoir No. 3 discharges include flows over bituminous surfaced emergency spillway with crest at EI. 396.5.

\$ Present discharge capability of Res. No. 1 is approximately 3,500 cfs over existing spillway crest at EI. 258.6. No revisions are proposed at this time due to the need for additional field information and engineering study (currently in progress).

PROJECT STORM - The reservoir proposals are based on passing this storm with normal freeboard for wave and wind action. The storm is basically a repeat of the August 1955 storm, as it occurred over Westfield, Mass., relocateed to occur over the West Hartford reservoirs.

EMERGENCY STORM - The reservoir proposals are based on passing this storm with nominal freeboard. The storm is a binary and synthetic consisting of a 2-hour rainfall total of 13.55" (7/8 of maximum possible), precip. led and followed by light rainfall.

B-13

WEST HARTFORD RESERVOIR NO. 1

Statistics Pertinent to
PROPOSED EMERGENCY SPILLWAYWatershed Area -

1.30 Sq. mi.	above South Flood Control Reservoir
0.60 "	Reservoir No. 3
1.50 "	Reservoir No. 5 (including Reservoir No. 2 and 30% of Talcott Flood Control Reservoir)
<u>1.00</u> "	Independent
<u>4.40</u> "	TOTAL

Capacity of Reservoir - 137 Million Gallons or 420 Acre-Feet

Dam - Earth fill type, completed in 1868, maximum height of about 43 feet, top width of about 25 feet, top at El. 267.4 Met. Dist. Datum, 8.8-foot freeboard on principal spillway.

Principal Spillway - Concrete weir, crest at El. 258.6, about 45 feet long.

Discharge channel in earth cut, base width about 18 feet, dry rubble toe walls, average invert slope of about 0.01. Stone masonry arch bridge over spillway channel, 18-foot span and 12-foot height.

Proposed Emergency Spillway - Earth cut, 100-foot base width, invert crest at El. 264.0 with $0.01 \pm$ slope.

Maximum Flood on Record (99-years of record) -

Occurred in August 1955 when the reservoir was empty and resulted in maximum water level at El. 261.6±, or 3.0 feet above crest of principal spillway and leaving 5.8 feet of freeboard. Principal spillway peaked at 600 to 700 cubic feet per second (cfs).

Repeat of Maximum Flood on Record -

If the August 1955 storm reoccurred with the reservoir full at the start of the storm and including the effects of upstream reservoirs and improvements built since 1955, the reservoir level would again crest at El. 261.6, or 3.0 feet above crest of principal spillway and leaving 5.8 feet of freeboard on the dam. This maximum water level would still be 2.4 feet below the crest of the emergency spillway.

Water Bureau's Project Storm -

This storm is a reconstruction of the August 1955 rainfall over a 20-square mile area in Westfield, Mass. transposed to our West Hartford Reservoirs. This storm totals 18.24 inches in 34 hours and is the design storm used for the Park River Flood Detention Reservoirs. The reservoir level would crest at El. 264.7, or 6.1 feet above crest of principal spillway and leaving 2.7 feet of freeboard. Principal spillway would peak at 1,650 cfs and the emergency spillway, with an 0.7-foot overflow head, would peak at 170 cfs with 0.4-foot flow depth and 4.0-foot per second (fps) velocities.

Maximum Spillway Capacities -

With the reservoir level a nominal 6" below the top of the dam, the principal spillway would discharge about 2,500 cfs and the emergency spillway would discharge about 1,500 cfs with about 2-foot flow depth and velocities of about 8 fps. This 4,000 cfs total discharge capacity is approximately two times the peak inflow rate from the project storm and three times the peak inflow rate from a repeat of the August 1955 storm.

WEST HARTFORD RESERVOIR NO. 1

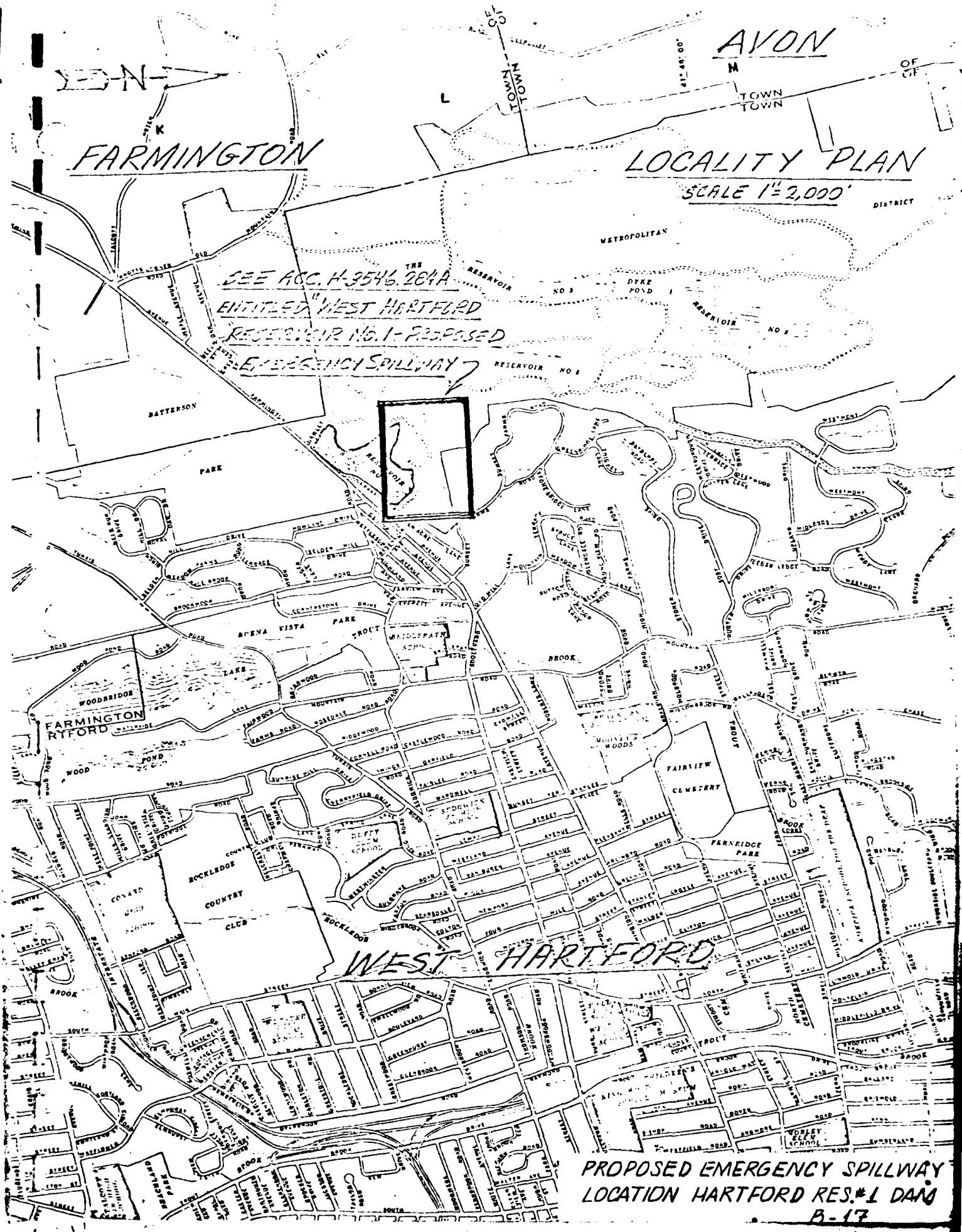
Statement of Purpose for
PROPOSED EMERGENCY SPILLWAY

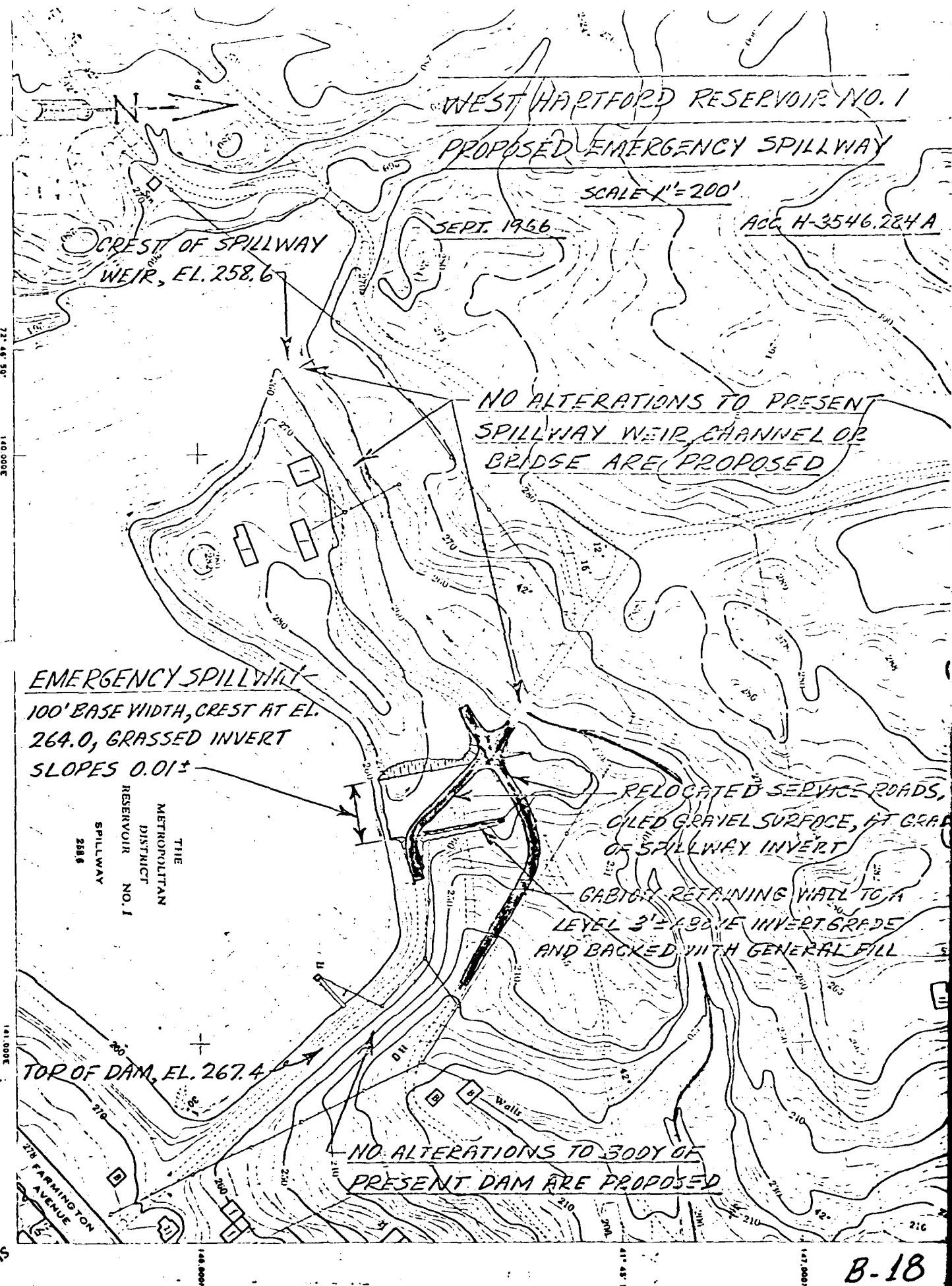
In the fall of 1964, the Water Bureau made certain revisions to its Reservoirs 2, 3, 5 and 6 in West Hartford and Bloomfield, to improve their hydrologic capacity and safety. Since major structural changes to a dam were required only on Reservoir 5, a formal construction permit was issued by your Commission for that project and the balance of the improvements were authorized without formal permits.

No improvements to Reservoir 1 were made at that time since the necessary field work and engineering studies were not complete. Unlike the other reservoirs, Reservoir 1 is not vital to the operations and safety of our Water Treatment Plant, so that the expense of any improvements must be justified only by the increased safety to property downstream thereof. To this end, we propose to construct an emergency spillway to augment the existing principal spillway. It would be constructed at such a level that the existing principal spillway would discharge twice its maximum flow on record before the emergency spillway would start to function. The emergency spillway would function to prevent overtopping of the dam proper for larger flows.

Attached is a locality plan, a plan of the proposed improvements, a tabulation of pertinent physical and hydrologic statistics, and a set of the proposed contract and construction drawings. This proposal was discussed in general in October 1965 with Mr. Curry and our engineering staff. The "gabions" are galvanized wire mesh baskets filled with quarry stone and would prevent flow and scour along the toe of the dam. The overflow velocities are within the design range of the Soil Conservation Service flood detention dams and the oiled gravel roads across the invert would minimize the chance of scour.

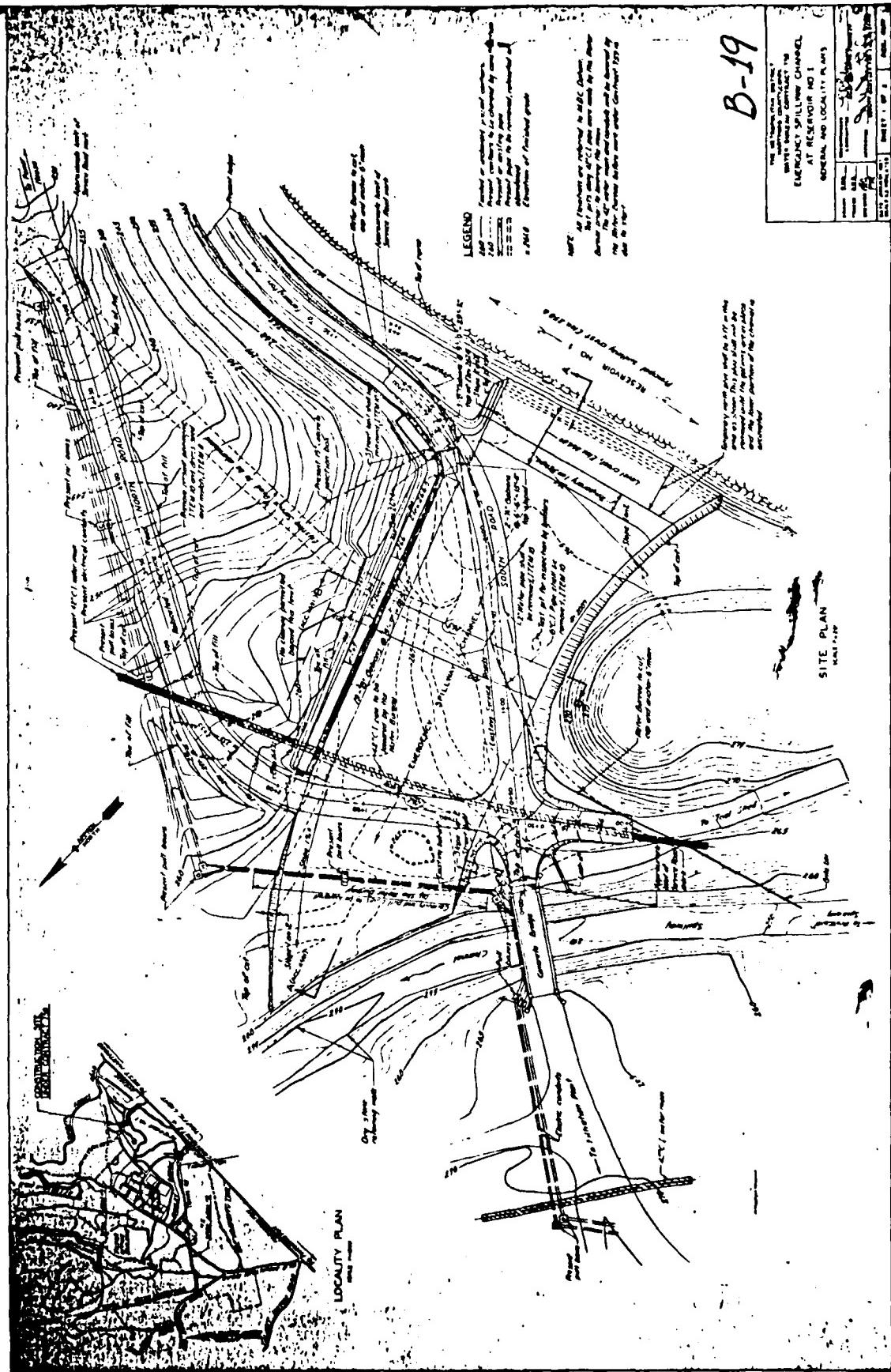
Funds are available in the 1967 Water Bureau budget for this work and it should be completed before the 1967 hurricane season if possible. To accomplish this, we must lower the 42-inch water main crossing the spillway area by April 1 so that early receipt of the permit is vital.

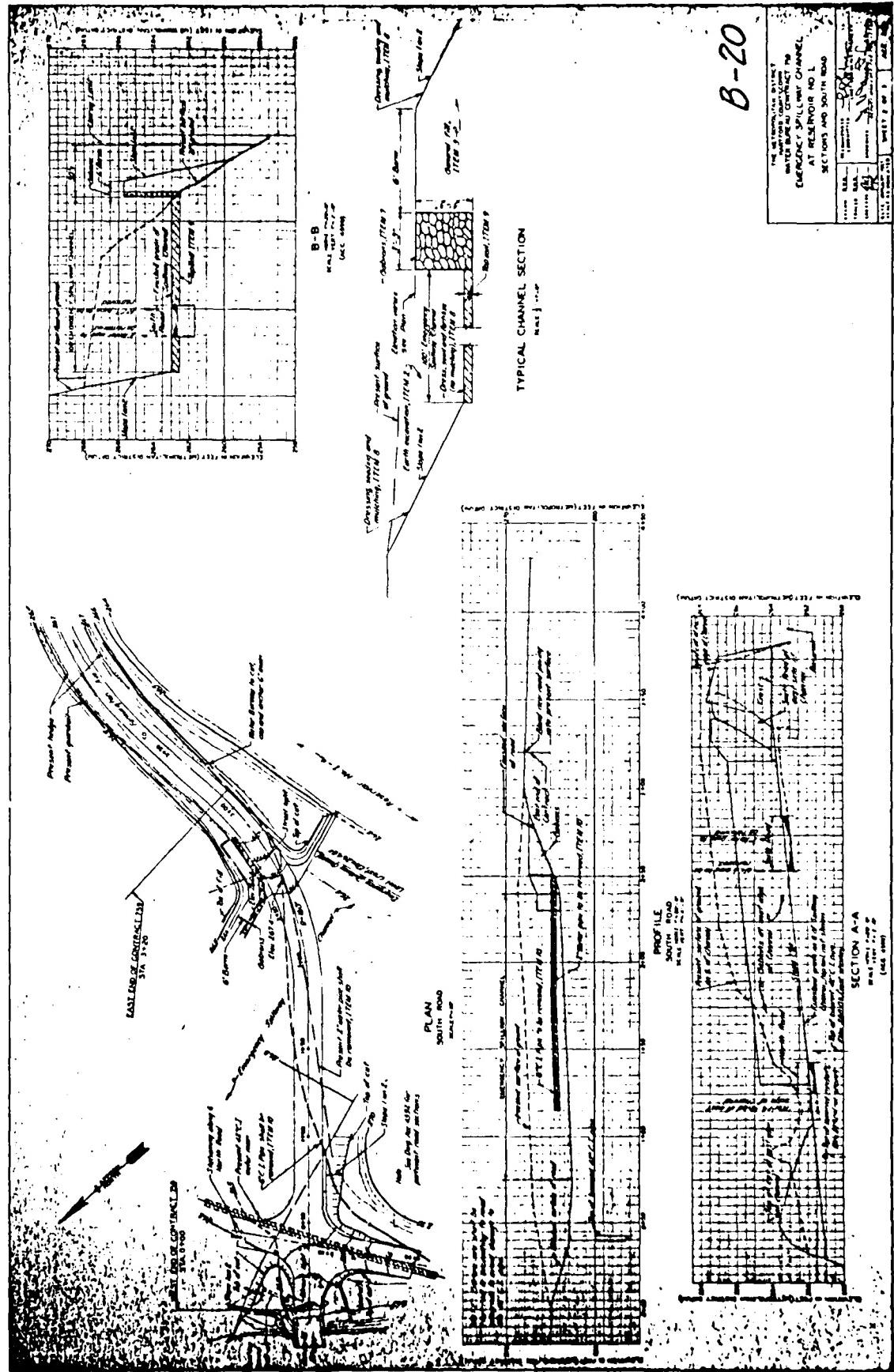


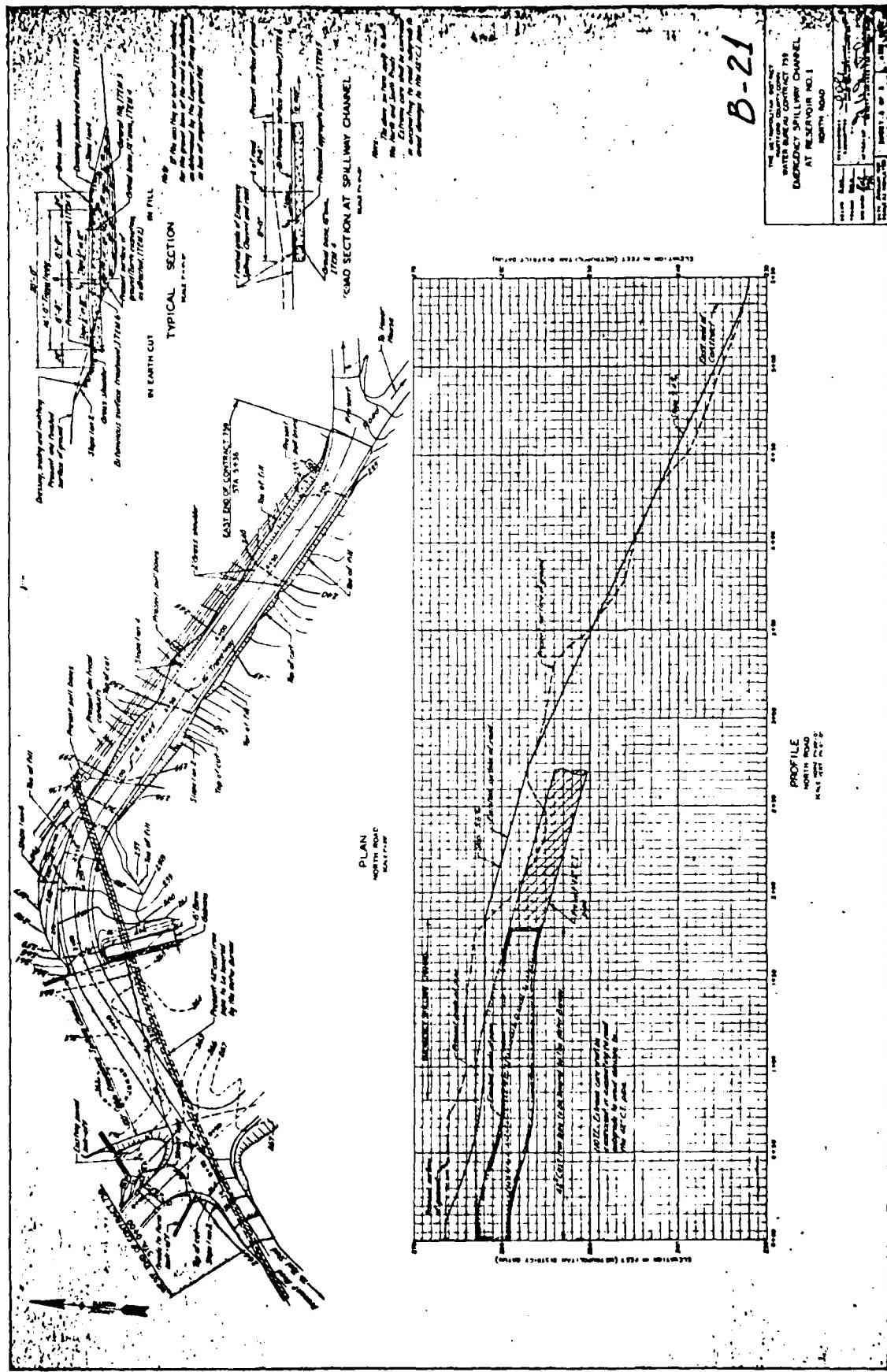


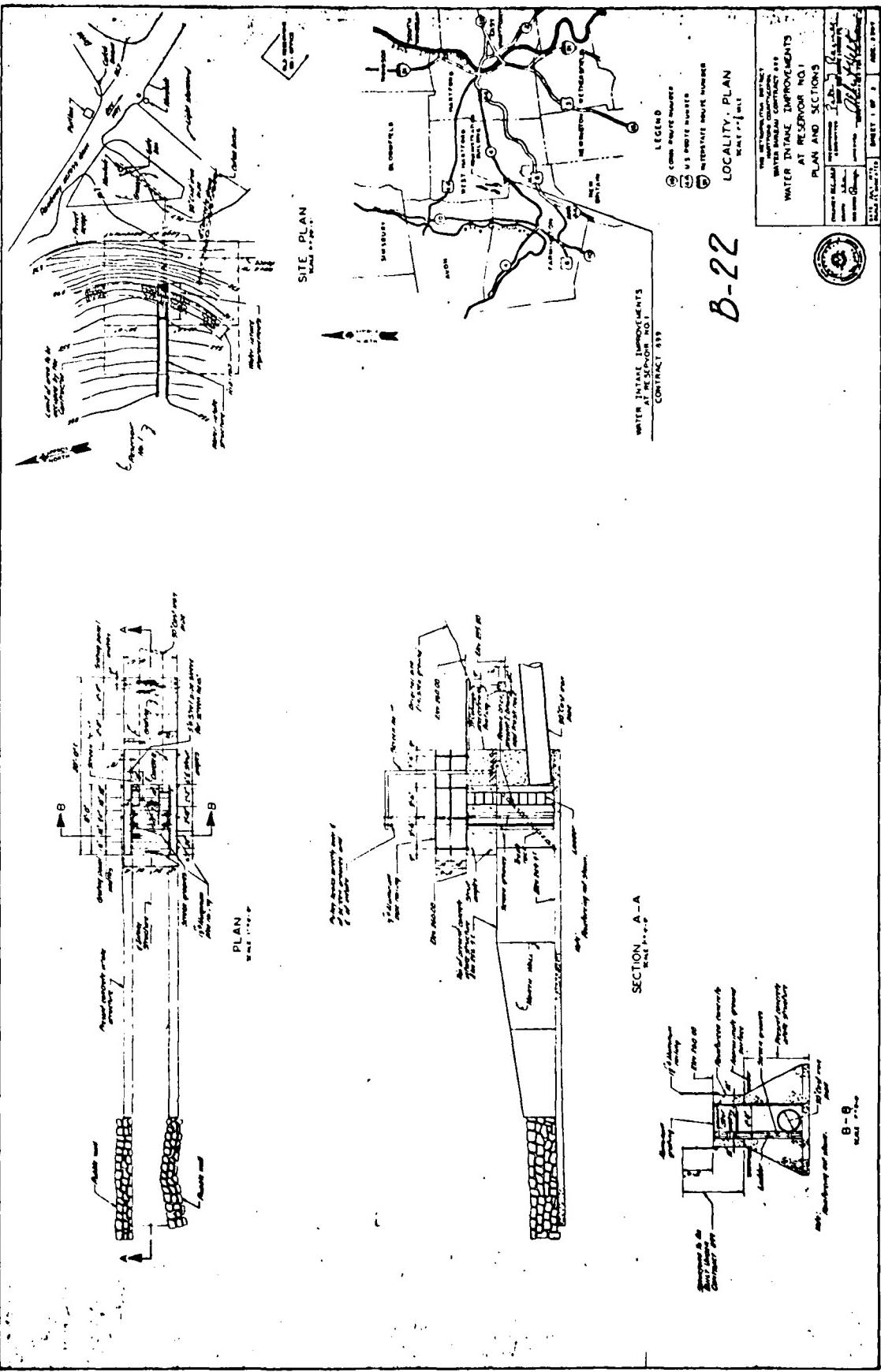
B-19

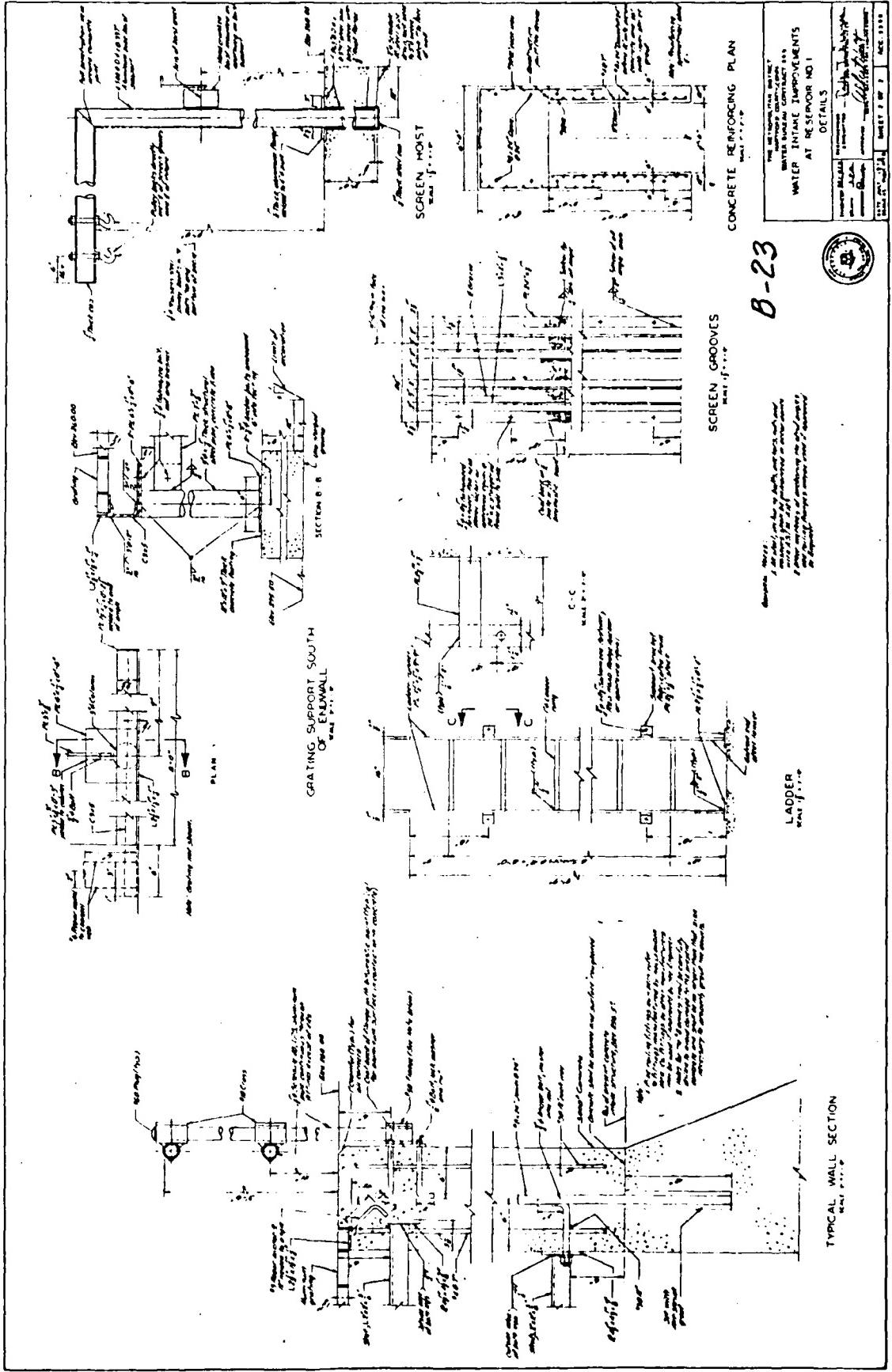
**EMERGENCY SPILLWAY CHANNEL
AT RESERVOIR NO 1
GENERAL AND LOCALITY PLANS**











B-24

TER BUREAU OF
POLITAN DISTRICT
ING OFFICE

SUBJECT Piezometers at Reservoir No. 1
Dam

FILE NO.

三

Elevations Top of Piezometer Pipes, MDC. Datum									
P-1 T	P-2 (m)	P-3 (B)	P-4 T	P-5 (m)	P-6 (m)				
Top of piezometer: E1. 248.05	E1. 247.71	E1. 226.04	E1. 268.31	E1. 249.99	E1. 249.10				
Around E1. + E1. 267.31	E1. 245.91	E1. 225.12	E1. 267.31	E1. 248.61	E1. 248.1				
Date	Reading Et. Water	Reading Et. Water	Reading Et. Water	Reading Et. Water					
July 18, 77	20.9 Dry	21.9 Dry	22.0 Dry	20.2 Dry	21.2 Dry	21.2 Wet	21.2 Wet	21.2 Wet	21.2 Wet
July 19, 77	20.7 Dry	21.9 Dry	22.0 Dry	20.2 Dry	21.2 Dry	21.2 Wet	21.2 Wet	21.2 Wet	21.2 Wet
July 30, 77	"	"	"	"	"	"	"	"	"
1:37 "	6.3	8.7	7.5	6.2	5.6	5.2	4.8	4.8	4.8
1:38 "	6.3	8.7	7.5	6.2	5.6	5.2	4.8	4.8	4.8
1:39 "	6.3	8.7	7.5	6.2	5.6	5.2	4.8	4.8	4.8
1:40 "	6.3	8.7	7.5	6.2	5.6	5.2	4.8	4.8	4.8
July 29, 77	20.9 Dry	21.9 Dry	22.0 Dry	20.2 Dry	21.2 Dry	21.2 and post night			
July 26, 77	20.9 Dry	21.9 Dry	22.0 Dry	20.2 Dry	21.2 Dry	21.2 Wet	21.2 Wet	21.2 Wet	21.2 Wet
July 29, 77	20.9 0.2 mms	21.9 Dry	22.0 Dry	20.2 Dry	21.2 Dry	21.2	21.2	21.2	21.2
Aug. 2, 77	20.7 0.1 mms	21.9 0.1 mms	22.0 0.1 mms	20.2 0.1 mms	21.2 0.1 mms	21.2	21.2	21.2	21.2
Aug. 5, 77	20.7 0.1 mms	21.9 0.1 mms	22.0 0.1 mms	20.2 0.1 mms	21.2 0.1 mms	21.2	21.2	21.2	21.2
Note: Rain previous day and last night									
Aug. 15, 77	20.9 Pump	21.9 Pump	22.0 Pump	20.2 Pump	21.2 Pump	21.2 Pump	21.2 Pump	21.2 Pump	21.2 Pump
Aug. 22, 77	20.7 Pump	21.9 Pump	22.0 Pump	20.2 Pump	21.2 Pump	21.2 Pump	21.2 Pump	21.2 Pump	21.2 Pump
Elevation bottom of piezometer E1. 247.0 ±	E1. 226.0 ±	E1. 215.0 ±	E1. 218.1 ±	E1. 228.5 ±	E1. 218.8 ±				

BUREAU OF
STAN DISTRICT
RING OFFICE

SUBJECT /
_____ / _____
COMPUTER

SUBJECT Piezometer Readings at
Res. & I Dams

B-25

FILE NO.
Acc. No.
DATE

Elevations Top of Piezometer Pipes, M.D.C. Datum:

B-26

Barometer Readings

Surface
Water
?

P₁ P₂ P₃ P₄ P₅ P₆

Sept 6 Dry Damp 223.9 Dry 229.4 223.8

Sept 12 Dry Damp 223.5 Dry 229.25 223.55

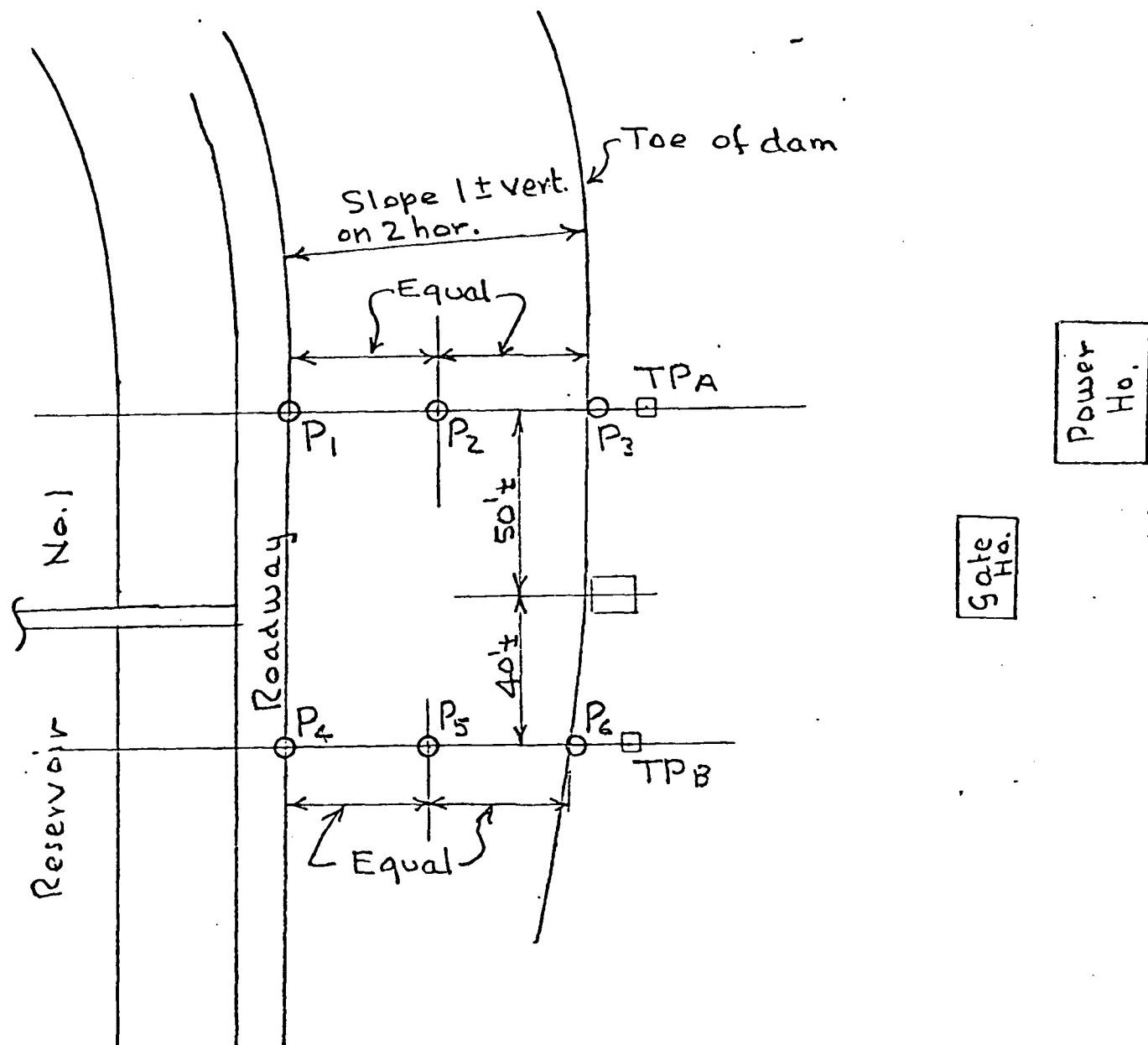
Nov. 21 20.8 21.9 224.2 248.6 230.3 223.9
977 Damp Damp

Nov 28 20.8 21.9 224.3 248.9 230.3 223.9
Damp Damp

Dec 5 Dry Damp 224.4 249.8 230.6 224

FORM NO. THE WATER BUREAU OF THE METROPOLITAN DISTRICT ENGINEERING OFFICE	SUBJECT	Resvr No. 1 Dam - Toe Drainage Study - Piezometer & Test Pit Locations	S-1407
			FILE NO.
			Acc. No. H-4530
COMPUTER	PSR	CHECKED BY	DATE Apr. '77

B-27



Piezometers

P₁, P₂, P₄, P₅
P₃, P₆

20 ft deep.
10 ft deep.

Test Pits

Hand dug, 4 ft deep, samples at 1, 2, 3, 4 ft

THE WATER BUREAU OF
METROPOLITAN DISTRICT
ENGINEERING OFFICE

SUBJECT

Piezometers, Res. No. 1 Dam
West Hartford

FILE NO.

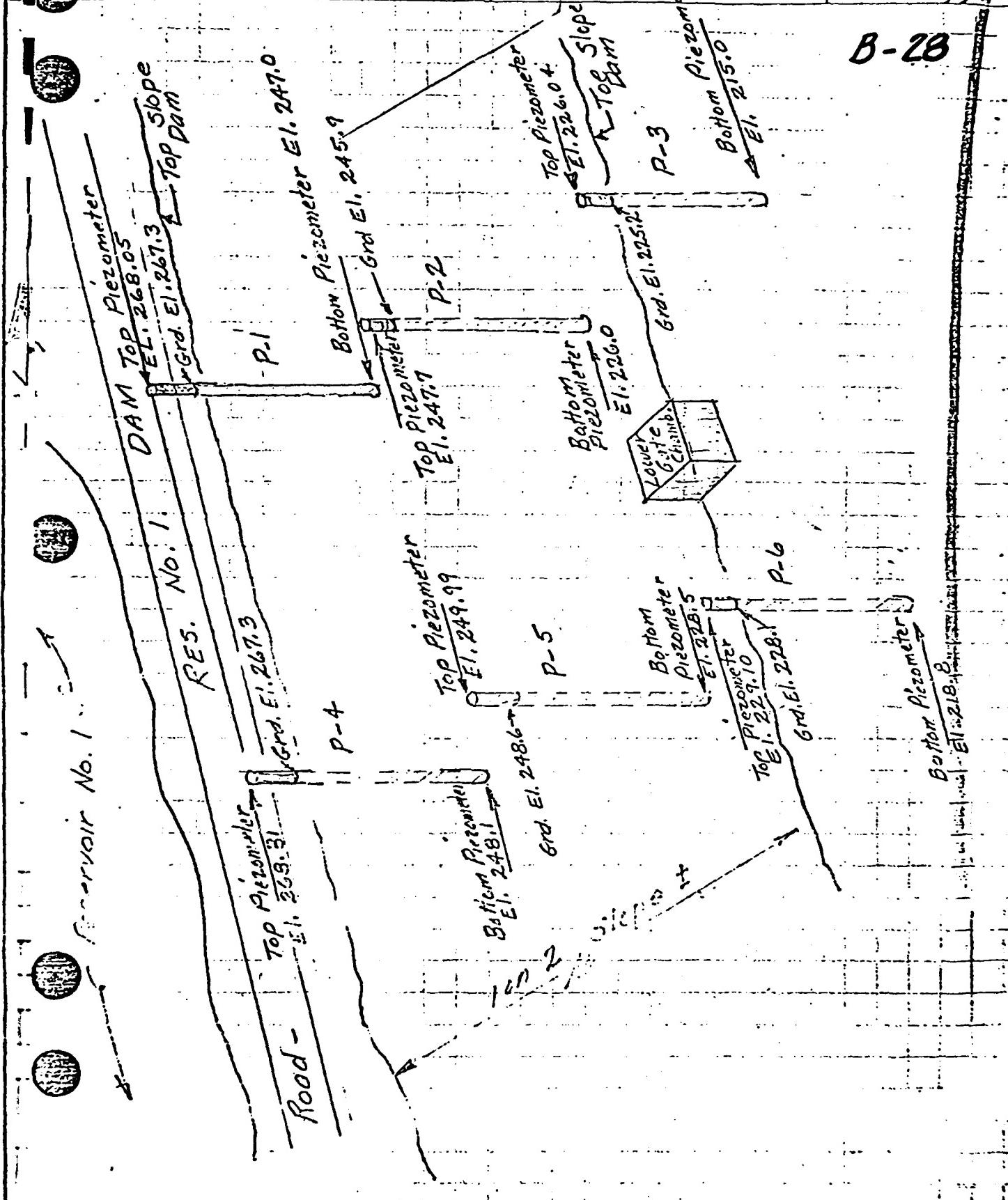
Acc. No.

DATE JULY, 1977

COMPUTER RJF

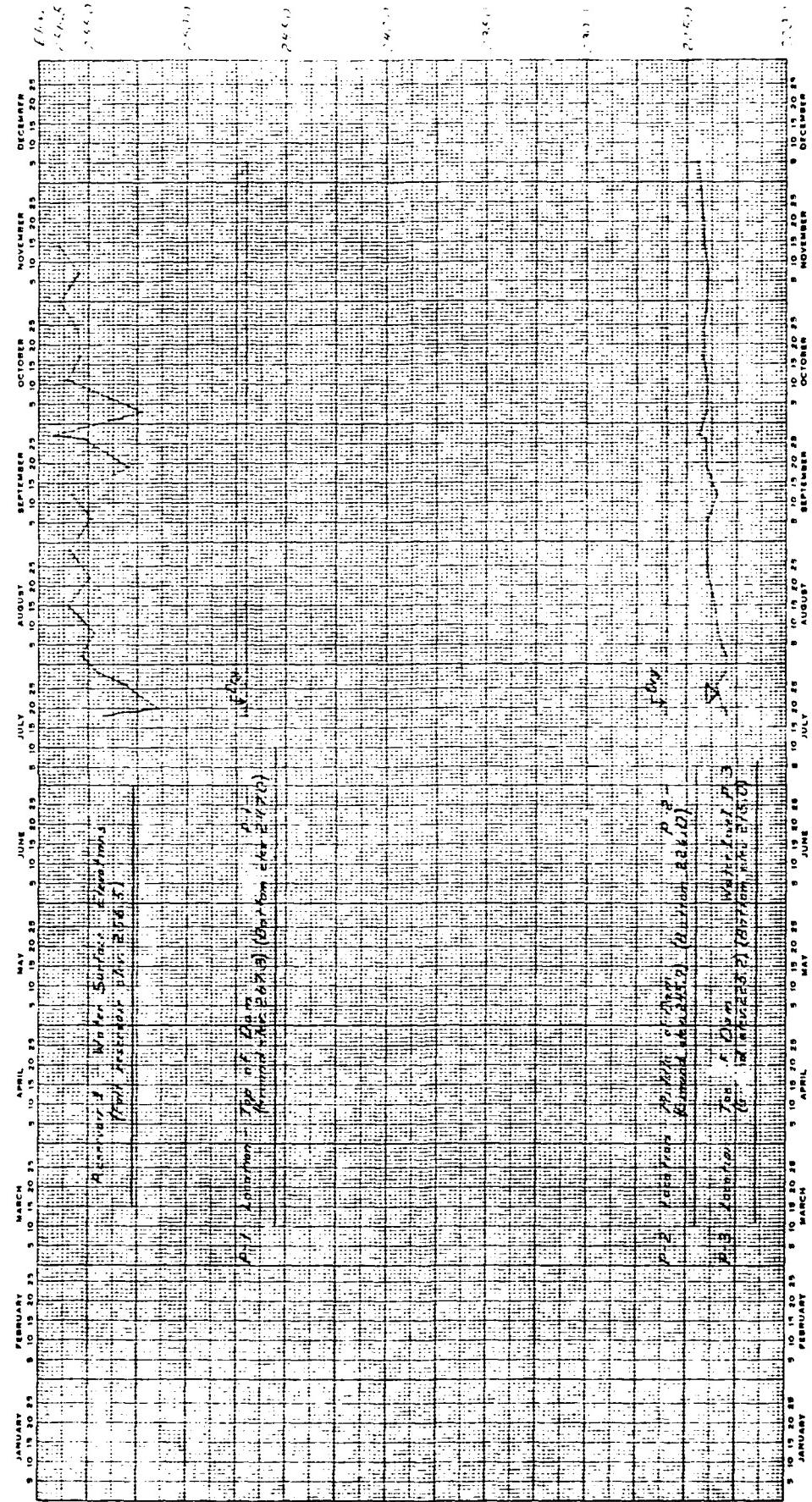
CHECKED BY

B-28



RESERVOIR 1 Dnm
PIEZOMETER WATER LEVELS
1977

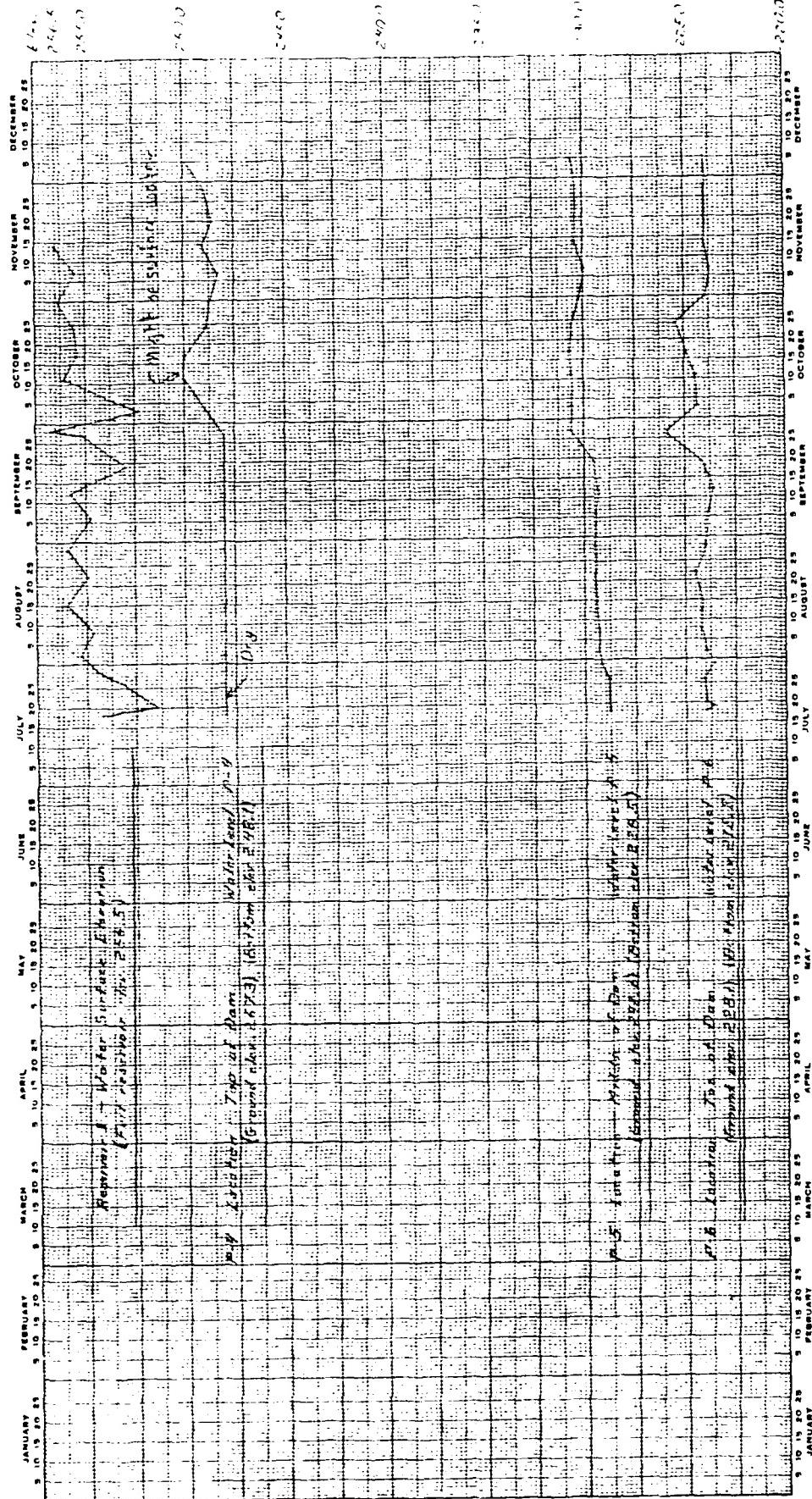
H-46310-14



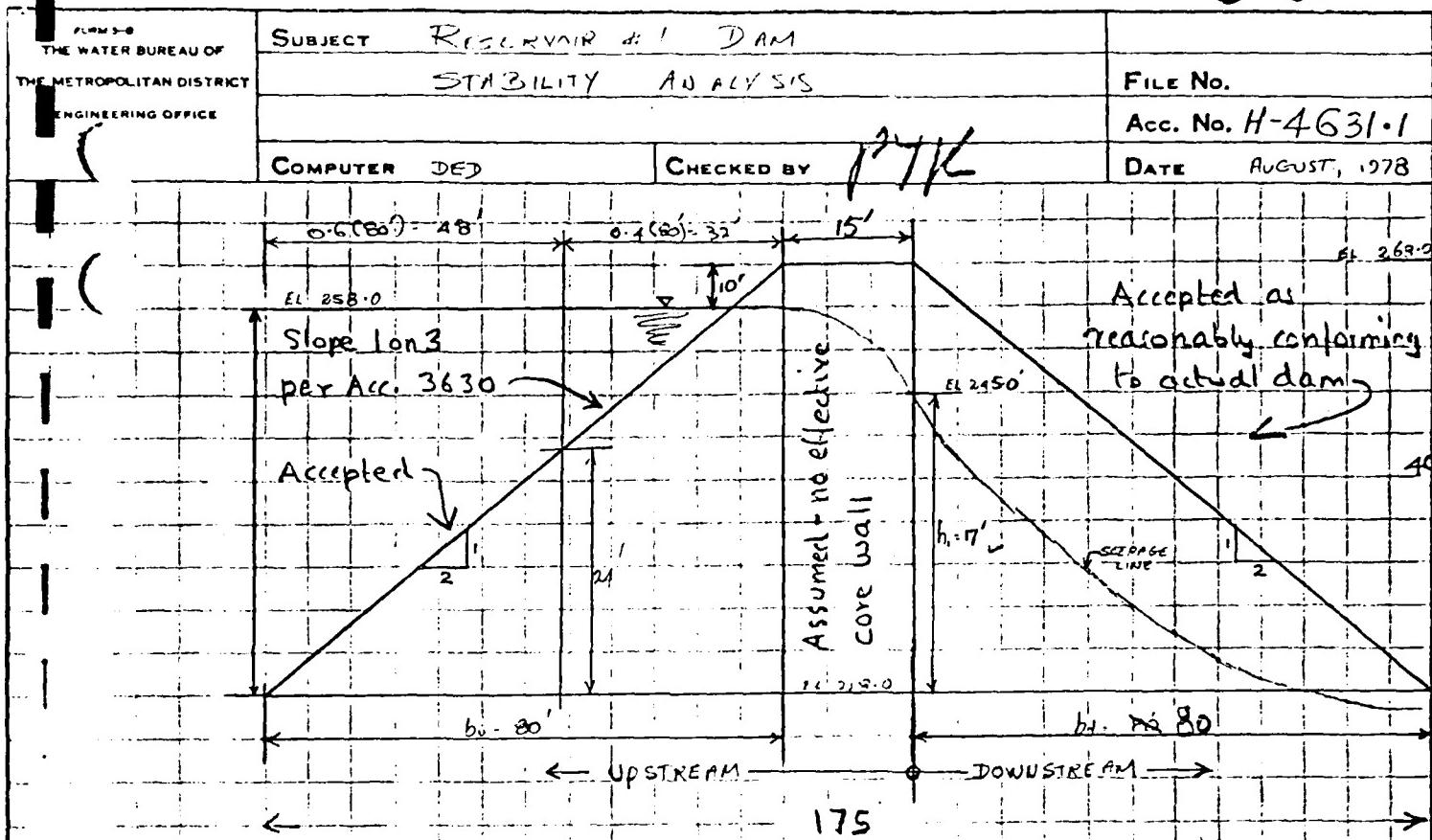
RESERVOIR DAM

PIEZOMETER WATER LEVELS

1977



B-31



REFERENCES:-
 (1) ENGINEERING FOR DAMS, JUSTIN KUNDS & CREAGER VOL II
 (2) SOIL MECHANICS & ENGINEERING PRACTICE, TERZA & GILL B PECE.

ASSUMPTIONS: BASED ON SIEVE ANALYSIS & CLASSIFICATION OF SOIL IN THE VICINITY (TOE DRAIN PROJECT) THE SOIL CHARACTERISTICS SHOULD CLOSELY APPROXIMATE THOSE CHARACTERISTICS WHICH ARE DISPLAYED BY CATE GOBY # 4 OF TABLE G.3 ON PAGE 28 OF TERZAGHI AND PECE (par. 30%, e = 0.43, 116 lb/c.f. dry, 135 lb/c.f. sat.)
 - ALSO 12% moist -

FROM LACK OF READILY AVAILABLE INFORMATION ASSUME THAT THE ADJUNCTS OF THE MAIN CROWNMENT HAVE A NEGLECTABLE EFFECT ON THE STRUCTURE. WHEN TAKEN INTO ACCOUNT THESE ADJUNCTS WILL HAVE A POSITIVE INFLUENCE ON THE SAFETY OF THE STRUCTURE.

THE MAIN DIMENSIONS OF THE STRUCTURE ARE AS IN THE DIAGRAM ABOVE. MOST OF THESE DIMENSIONS WERE TAKEN FROM THE PRELIMINARY TOE DRAIN PROJECT STUDIES.

B-32

FORM 3-B THE WATER BUREAU OF THE METROPOLITAN DISTRICT ENGINEERING OFFICE	SUBJECT	RESCINDIA = 1 DAM	
	STABILITY	ANALYSIS	FILE NO.
	COMPUTER D.F.D.	CHECKED BY PTK	Acc. No. H-4631-2 DATE AUGUST 1978

STABILITY OF EARTH DAM AGAINST SIDEWALL PRESSURES.

ASSUME THAT 65% OF MATERIAL IS SUBMERGED

Reasonable →

$$\text{Unit weight} = 0.65 \left(135 \frac{\text{ft}}{\text{ft}^3} - 62.5 \frac{\text{ft}}{\text{ft}^3} \right) = 47.13 \frac{\text{ft}}{\text{ft}^3}$$

Assume that 35% OF MATERIAL IS MOIST

$$\text{Unit weight} = 0.35 \left(120 \frac{\text{ft}}{\text{ft}^3} \right) = 42.0 \frac{\text{ft}}{\text{ft}^3}$$

AVERAGE EFFECTIVE UNIT WT OF SECTION =

$$\text{X-SECTION AREA} = \frac{175}{2} \times 10 = 875 \text{ ft}^2$$

$$\text{SECTION WEIGHT} = 875 \text{ ft}^2 \times 120 \frac{\text{ft}}{\text{ft}^3} = 10500 \text{ ft}^3 \times 62.5 \frac{\text{ft}}{\text{ft}^3}$$

$$= 343.75 \frac{\text{ft}}{\text{ft}^2} = 172 \text{ TON}$$

$$\text{AVERAGE PRESSURE} = \frac{172 \text{ TON}}{875 \text{ ft}^2} = 0.19 \text{ TON/ft}^2$$

Conservative *

$$\text{SHEAR RESISTANCE} = 172 \text{ TON} \times 7 \sin 26^\circ$$

$$= 172 \text{ TON} \times 0.473 = 81.83 \text{ TON}$$

for 26°

$$\text{SIDEWALL PRESSURE} = \frac{62.5 \times 30}{2} = \frac{1875}{2} = 937.5 \frac{\text{ft}}{\text{ft}^2} = 14.06 \text{ TONS/ft}^2$$

$$\text{OVERALL F.O.S.} = \frac{81.83}{14.06} = 5.8 = \underline{\underline{6.1}} \text{ - Very safe.}$$

$$\text{AVERAGE SHEAR} = \frac{172}{875} = 0.19 \text{ TON/ft}^2$$

* At Hogback for sandy gravel used 38° (Acc. H-2630, DS-1)
However Peck, Hanson & Thornburn "Foundation Engineering" 1965,
p. 91 give 27°-30° for silt, loam, 30°-35° dense silt.

B-33

FORM 3-8 THE WATER BUREAU OF THE METROPOLITAN DISTRICT ENGINEERING OFFICE	SUBJECT	RESISTIVE TO DEM	
	STABILITY ANALYSIS		FILE NO.
	COMPUTER D.C.B.	CHECKED BY <i>P.J.F.</i>	Acc. No. H-4631.3

HORIZONTAL SHEAR ON DOWNSTREAM PORTION OF DEM.

J.H.C book, p.717

$$H_d = \frac{W_d}{2} \tan^2(45^\circ - \phi) + W_d \cdot \frac{\gamma}{2}$$

$$= \frac{(10')^2}{2} (90.53 \frac{\gamma}{2} \tan^2(45^\circ - 13.25^\circ)) + \frac{62.5 \frac{\gamma}{2} \times (17')^2}{2}$$

$$= 27,233.81 + 9031.25 = 36,765.06 \text{ TON}$$

$$S_d = \frac{(10')^2 (90.53 \frac{\gamma}{2} \tan^2(45^\circ - 13.25^\circ))}{2 \times 80} + \frac{62.5 \frac{\gamma}{2} \times (17')^2}{2 \times 80} = 18.38 \text{ TON}$$

$$= 0.23 \text{ TON/ft} \quad \text{AVERAGE} \quad \text{TON/ft} \quad \checkmark$$

$$S_{pd} = \text{MAXIMUM UPLIFT STRESS} = 2 \times S_d = 2 \times 0.23 = 0.46 \text{ TON/ft}$$

No friction assumed below

$$\text{RESISTING FORCE } R_d = W_d \times \tan \phi + c_b$$

$$\text{TOTAL AREA OF DOWNSTREAM PORTION OF DEM} = \frac{80 \times 40}{2} = 1600 \text{ FT}^2$$

$$\text{AREA UNDER STRESS LINE} = \frac{17 \times 80}{2} = 680 \text{ FT}^2$$

2, error small.

$$W_d = 680 \times 72.5 \frac{\gamma}{2} \times 1 \text{ ft} + 90 \times 1 \times 124 \frac{\gamma}{2} \text{ ft}^2$$

$$= 24.65 \text{ TONS} + 60.76 \text{ TONS} = 85.41 \text{ TON}$$

$$R_d = 85.41 (0.420) = 35.62 \text{ TON}$$

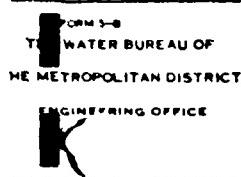
$$F_d = \frac{R_d}{H_d} = \frac{35.62}{18.38} = 2.37 \quad \checkmark \quad (2 \text{ min. desirable})$$

$$\text{UNIT SHEAR (@ PT. OF MAX. STRESS)} = 24 \text{ FT} \times 124 \frac{\gamma}{2} \times 1 \text{ FT} \times 0.499 = 0.74 \text{ TON/FT}$$

$$\text{F.O.S @ THIS POINT} = \frac{0.74}{0.46} = 1.61 \quad \checkmark$$

(1.5 desirable)
min.Adequate

D-24



SUBJECT	RESENVYD & CO., LTD.	FILE No.
	STABILITY ANALYSIS	
COMPUTER C.D	CHECKED BY PJK	DATE AUGUST 1975

HORIZONTAL SHEAR ON upstream portion of D.M. (Drawdown condition)

$$H_u = \frac{1}{2} w_f \tan^2(45^\circ - \phi) + \frac{w_h^2}{2} \cdot 0.6125$$

$$= (40')^2 \times 135 \text{ ft}^2/\text{ft} \tan^2(45^\circ - 33.5^\circ) + 62.5 \text{ ft}^2/\text{ft} \times 17$$

$$= 41357.161 + 903125 = 50388.41 \text{ ft}^2 = 25.2 \text{ TON}$$

AREA OF upstream portion of D.M. = $\frac{80}{2} \times 50' = 1600 \text{ ft}^2 + 15' \times 40'$
EFFECTIVE WEIGHT (unit) under SUDRAW conditions
 $= 35.5 \text{ ft}^2/\text{ft} = 60.5 \text{ ft}^2/\text{ft}$

$$\text{TOTAL EFFECTIVE weight} = (600/600) \text{ ft}^2 \times 17 \times 72.5 \text{ ft}^2/\text{ft} = 159,500 \text{ ft}^2 \times 7.75 \text{ TON}$$

$$\text{RESISTING SHEAR STRESS} = 7.75 \text{ ft}^2/\text{ft} = 7.75 \times 0.499 = 3.8 \text{ TON}$$

$$F_o = \frac{3.8}{25.2} = 1.58 \quad (1:5 \text{ desired min.})$$

$$\text{AVERAGE UNIT SHEAR } S_u = \frac{h^2 \tan^2(45^\circ - \phi)}{2(60')} + \frac{\text{weight}}{2(60')}$$

$$= \frac{(40')^2 \times 35 \text{ ft}^2/\text{ft} \tan^2(45^\circ - 33.5^\circ)}{2(80')} + \frac{17' \times 17' \times 62.5 \text{ ft}^2/\text{ft}^2}{2 \times 80'} = 25.2 \text{ TON}$$

$$= \frac{25.2 \text{ TON}}{80 \text{ ft}^2} = 0.315 \text{ TON/ft}^2$$

$$\text{MAXIMUM UNIT SHEAR } S_{u\max} = 2S_u = 2(0.315) = 0.63 \text{ TON/ft}^2$$

$$\text{Unit shear at pt. of Max. shear} = 29' \times 72.5 \text{ ft}^2/\text{ft} \times 0.499$$

$$= 838.76 \text{ ft}^2/\text{ft}^2 = 0.43 \text{ TON/ft}^2$$

$$F.O.S. = \frac{0.63}{0.43} = \frac{1.46}{0.43} \quad \left\{ \begin{array}{l} \frac{0.43}{0.63} = 0.7 \\ \text{Not too serious according to J.H+C book p. 724.} \end{array} \right.$$

SUMMARY

STABILITY FACTOR

AVERAGE

MINIMUM

STABILITY AGAINST HEADWAY PRESSURE

6.1 ✓

1.61 ✓ local

HORIZONTAL SHEAR STRESS

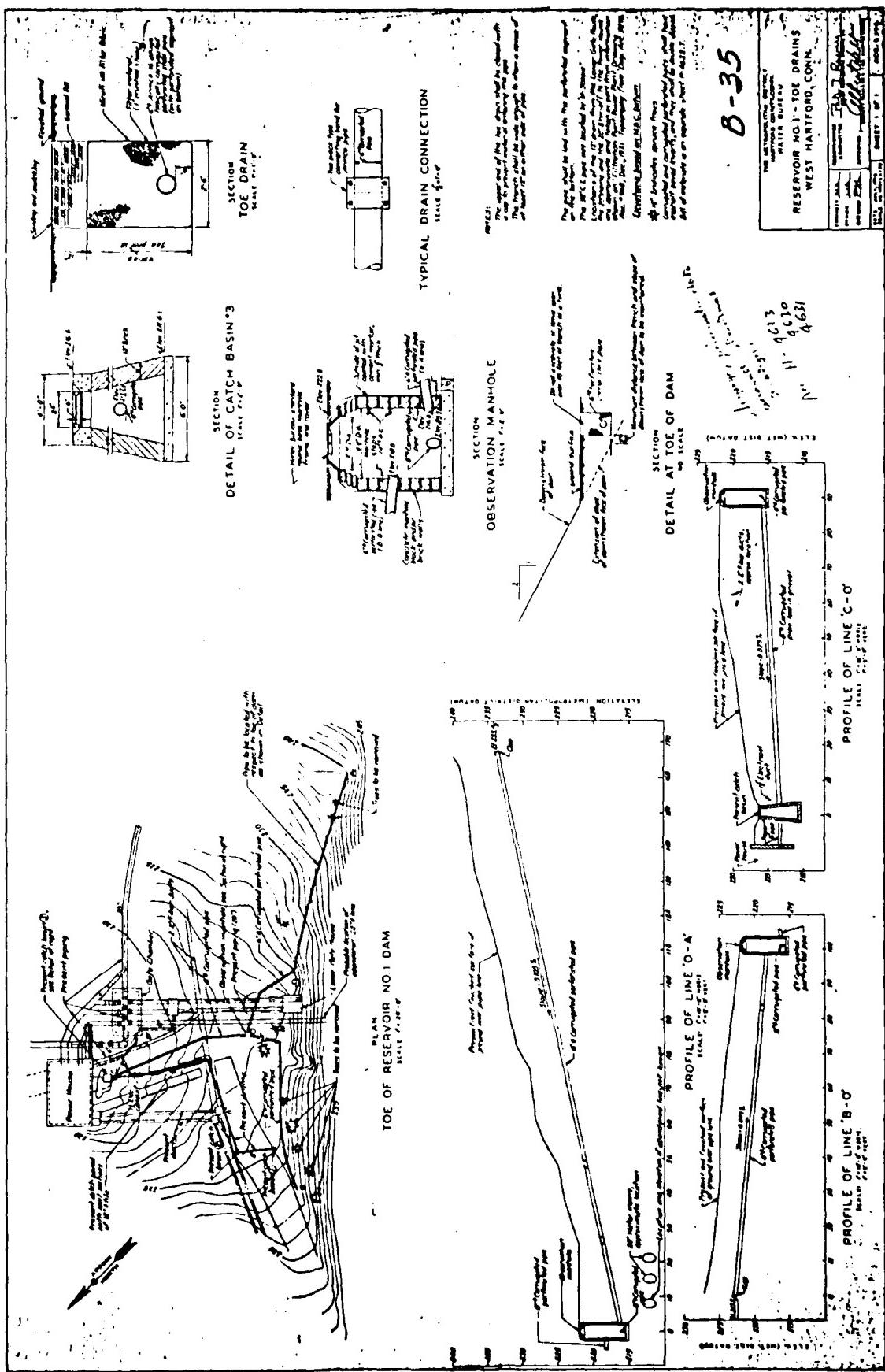
2.32 ✓ } overall

1.46 ✓ local

HORIZONTAL SHEAR STRESS (SUB. IN DRAWDOWN)

1.58 ✓

0.7 ✓



WATER SUPPLY
SEWERAGE

TELEPHONE
278-7850

THE METROPOLITAN DISTRICT

555 MAIN STREET - P.O. BOX 800
HARTFORD, CT 06101

3-PJR:jok

RECEIVED

FEB 19 1980

O'BRIEN & GERE
PHILADELPHIA, PA.

File: West Hartford
Dam Inspection

Mr. Leneord Beck
O'Brien and Gere
1617 J. F. Kennedy Blvd.
Suite 1760
Philadelphia, PA 19103

Dear Len:

In reply to your request for data on the Talcott Reservoir, I have taken the following data from the construction drawings. (I assume you have our 1" = 200 ft. scale maps of the area for location purposes.)

South Dam: principal spillway is a 30" pipe through dam, emergency spillway is 40 ft. wide, crest at Elev. 452.5.

North Dam: principal spillway is a 30" pipe through the dam, emergency spillway is 90 ft., crest at Elev. 452.5.

Both emergency spillways are grassed earth with crests 30' long (i.e. parallel to flow) and approach and discharge slopes ranging from 2 to 7%. The design high water level is at Elev. 455.4.

As I recollect, the spillways are designed to drain their proportionate share of the watershed. Our records state that 0.5 sq. mile of Reservoir No. 2 watershed lies above the flood control dam. I hope this information is of help to you.

Sincerely,

Peter J. Revill

Peter J. Revill,
Chief Design Engineer

B-36

APPENDIX C

PHOTOGRAPHS

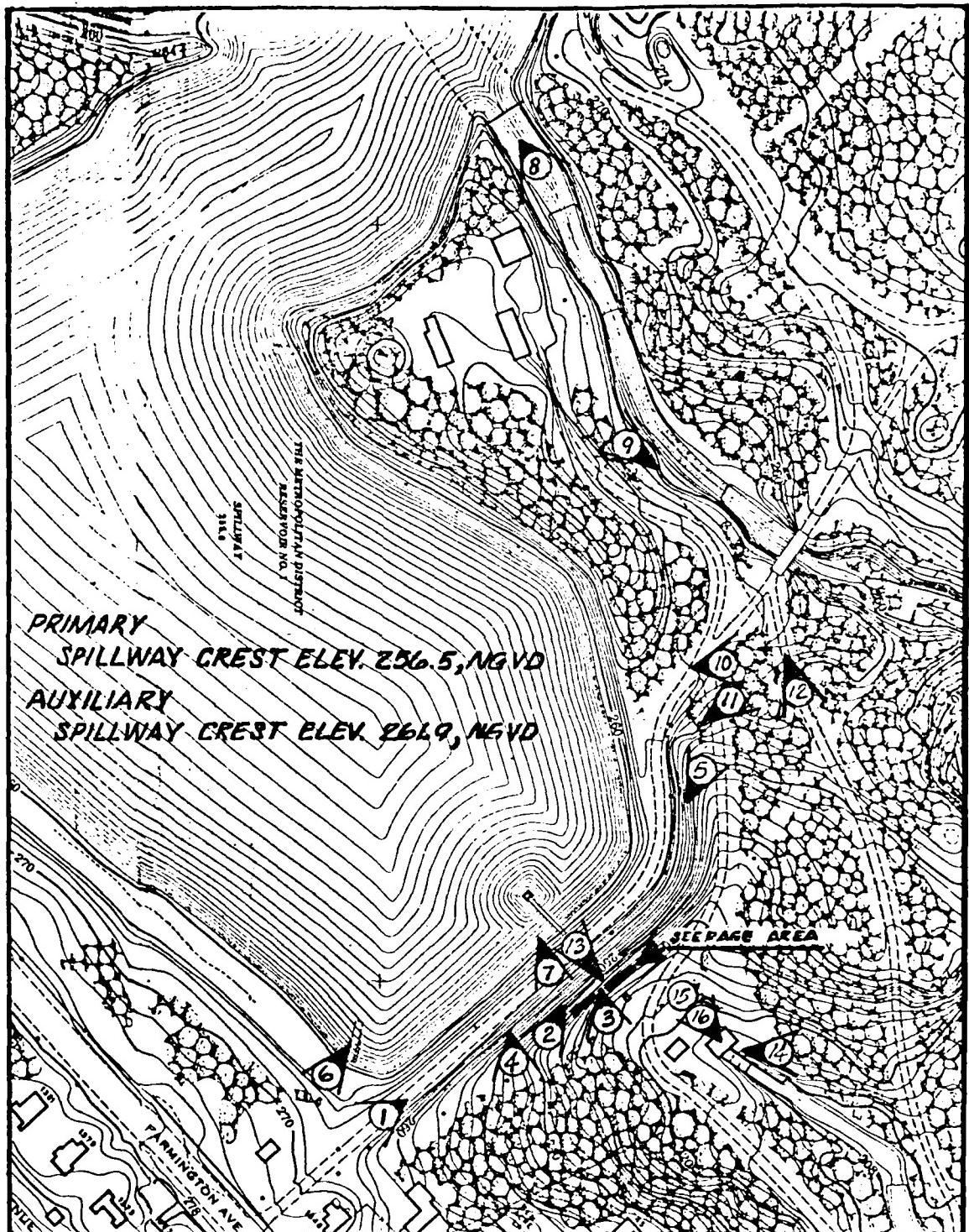
APPENDIX C
SELECTED PHOTOGRAPHS OF PROJECT

<u>LOCATION PLAN</u>	<u>Page No.</u>
Site Plan	A
Regional Plan	B
<u>PHOTOGRAPHS</u>	<u>Page No.</u>
No.	
1. View from the right abutment above the top of the dam with the gatehouse and catwalk shown on the left.	1
2. Downstream face of the dam showing vegetative cover and a depression in the earth embankment.	1
3. Seepage observed at the downstream toe of the dam.	2
4. Typical rodent hole in the downstream face of the dam.	2
5. Downstream face of the dam near the left abutment showing trees growing on the embankment.	3
6. Recently reconstructed inlet for the powerhouse water supply pipe.	3
7. Gatehouse and catwalk.	4
8. Looking upstream at the primary spillway weir section.	4
9. Typical view of the primary spillway outlet channel.	5
10. Looking upstream in the emergency spillway outlet channel towards the reservoir.	5
11. Gabion side slope protection along the right side of the emergency spillway outlet channel.	6
12. Opening in the levee along the right side of the emergency spillway outlet channel which would be sandbagged in the event of impending emergency spillway flow.	6
13. Powerhouse to the left and pump house to the right about 100 feet downstream of the dam.	7
14. Downstream side of the powerhouse with the tailrace in the foreground.	7
15. Inside the powerhouse showing the gate hoist pedestals in the background and the powered hoist unit in the foreground.	8
16. Electric power generating unit.	8

Appendix C, Cont'd.

PHOTOGRAPHS

<u>No.</u>		<u>Page No.</u>
17.	Potential damage area about 0.5 miles downstream from the dam.	9
18.	Potential damage area about 1.0 miles downstream from the dam.	9
19.	Potential damage area about 1.9 miles downstream from the dam.	10
20.	Potential damage area about 2.1 miles downstream from the dam.	10
21.	Potential damage area about 2.1 miles downstream from the dam.	11
22.	Potential damage area about 2.1 miles downstream from the dam.	11

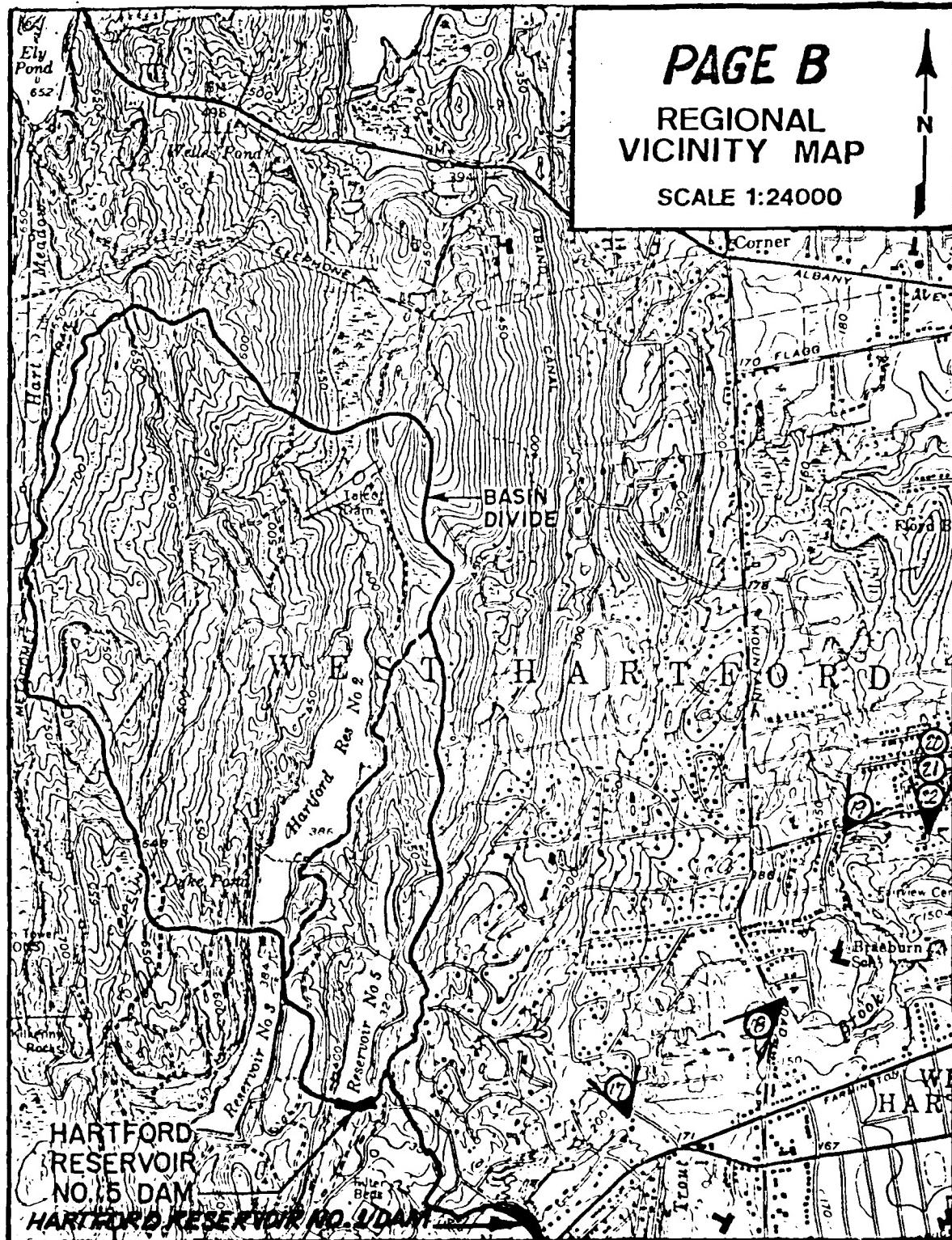


LEGEND THE LOCATION AND DIRECTION IN WHICH PHOTO
 WAS TAKEN AND THE NUMBER OF THE PHOTO

PG. A

PAGE B
REGIONAL
VICINITY MAP

SCALE 1:24000



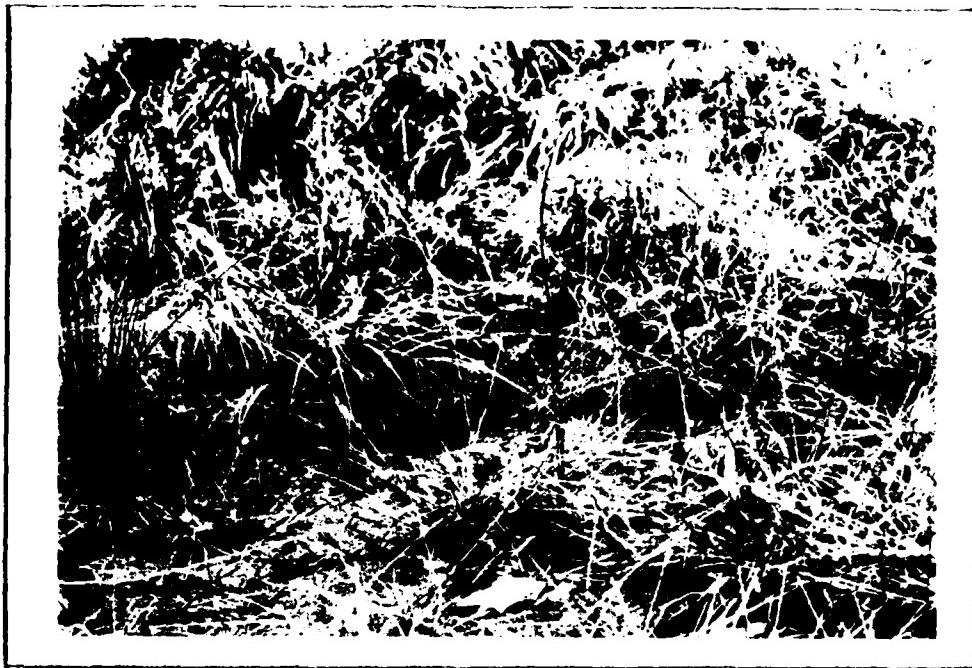
LEGEND ➤ THE LOCATION AND DIRECTION IN WHICH EACH PHOTO
WAS TAKEN AND THE NUMBER OF THE PHOTO



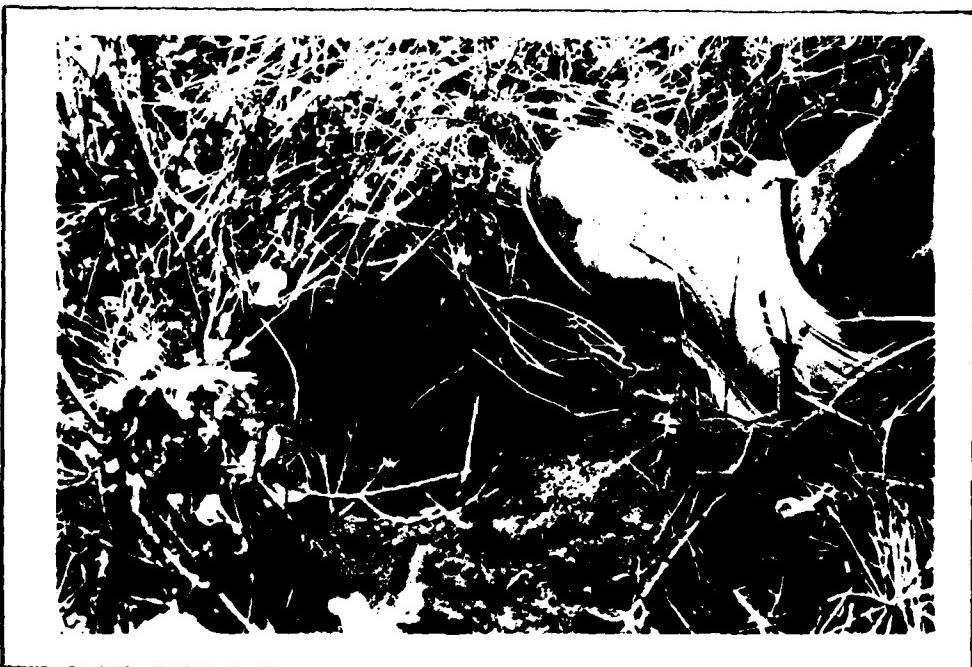
1. VIEW FROM THE RIGHT ABUTMENT ALONG THE TOP OF THE DAM WITH THE GATEHOUSE AND CATWALK SHOWN ON THE LEFT. (11/13/79)



2. DOWNSTREAM FACE OF THE DAM SHOWING VEGETATIVE COVER AND A DEPRESSION IN THE EARTH EMBANKMENT. (11/13/79)



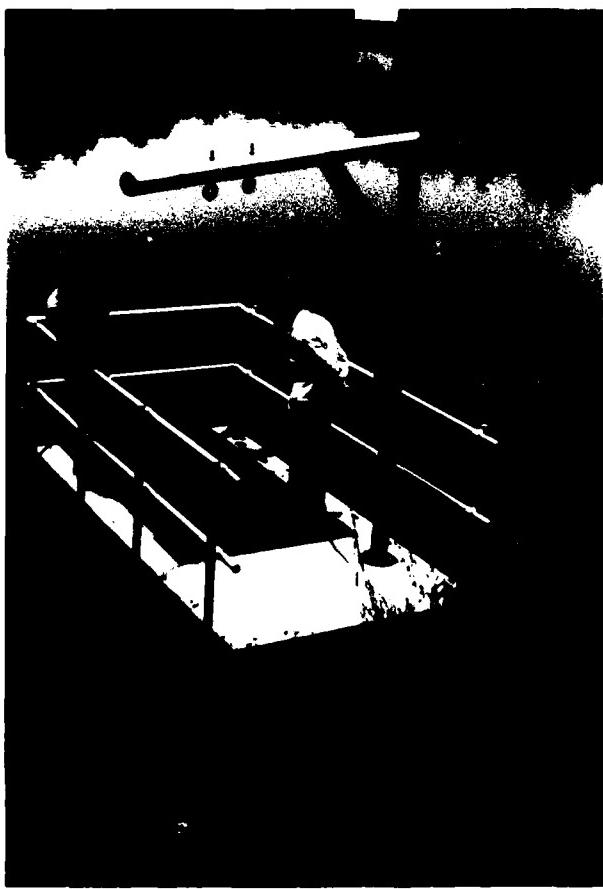
3. SEEPAGE OBSERVED AT THE DOWNSTREAM TOE OF THE DAM. (11/13/79)



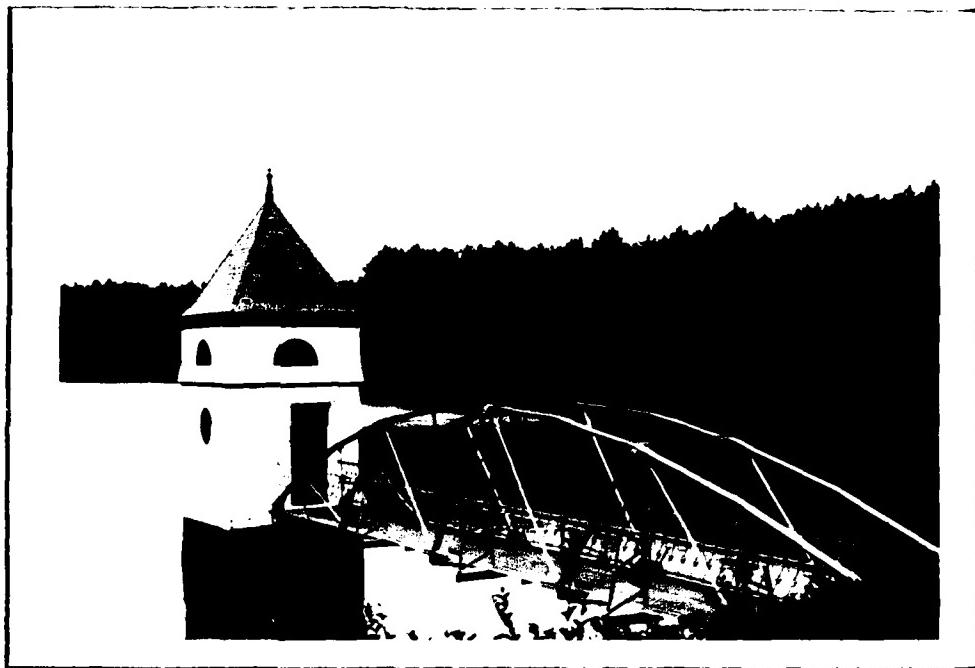
4. TYPICAL RODENT HOLE IN THE DOWNSTREAM FACE OF THE DAM.
(11/13/79)



5. DOWNSTREAM FACE OF THE DAM NEAR THE LEFT ABUTMENT SHOWING TREES GROWING ON THE EMBANKMENT. (11/13/79)



6. RECENTLY RECONSTRUCTED INLET FOR THE POWER HOUSE WATER SUPPLY PIPE. (11/13/79)



7. GATEHOUSE AND CATWALK. (11/13/79)



8. LOOKING UPSTREAM AT THE PRIMARY SPILLWAY WEIR SECTION.
(11/13/79)



9. TYPICAL VIEW OF THE PRIMARY SPILLWAY OUTLET CHANNEL.
(11/13/79)



10. LOOKING UPSTREAM IN THE EMERGENCY SPILLWAY OUTLET CHANNEL
TOWARDS THE RESERVOIR. (11/13/79)



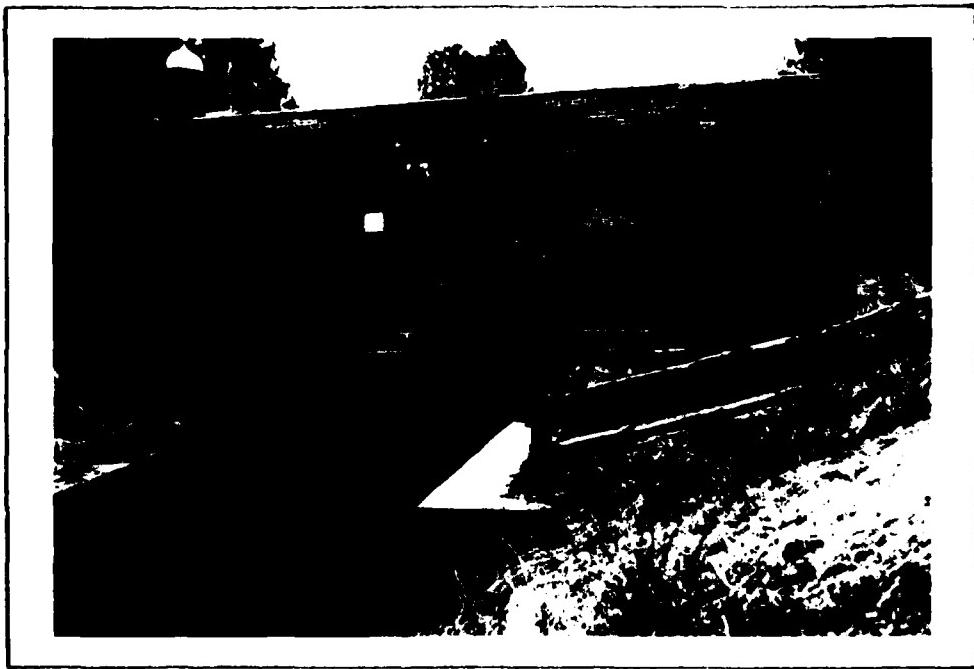
11. GABION SIDE SLOPE PROTECTION ALONG THE RIGHT SIDE OF THE EMERGENCY SPILLWAY OUTLET CHANNEL. (11/13/79)



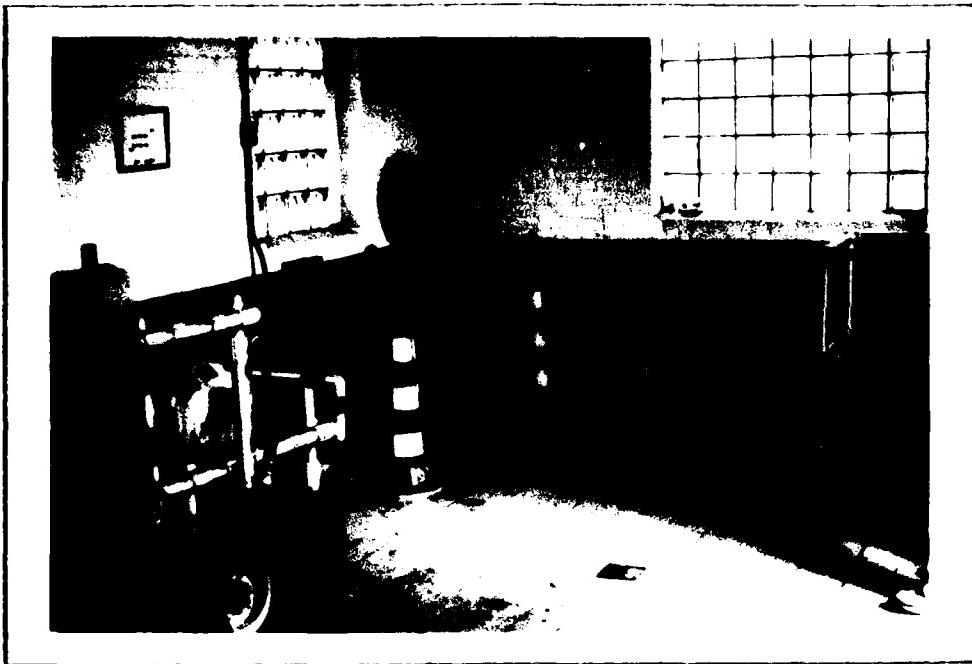
12. OPENING IN THE LEVEE ALONG THE RIGHT SIDE OF THE EMERGENCY SPILLWAY OUTLET CHANNEL WHICH WOULD BE SANDBAGGED IN THE EVENT OF IMPENDING EMERGENCY SPILLWAY FLOW. (11/13/79)



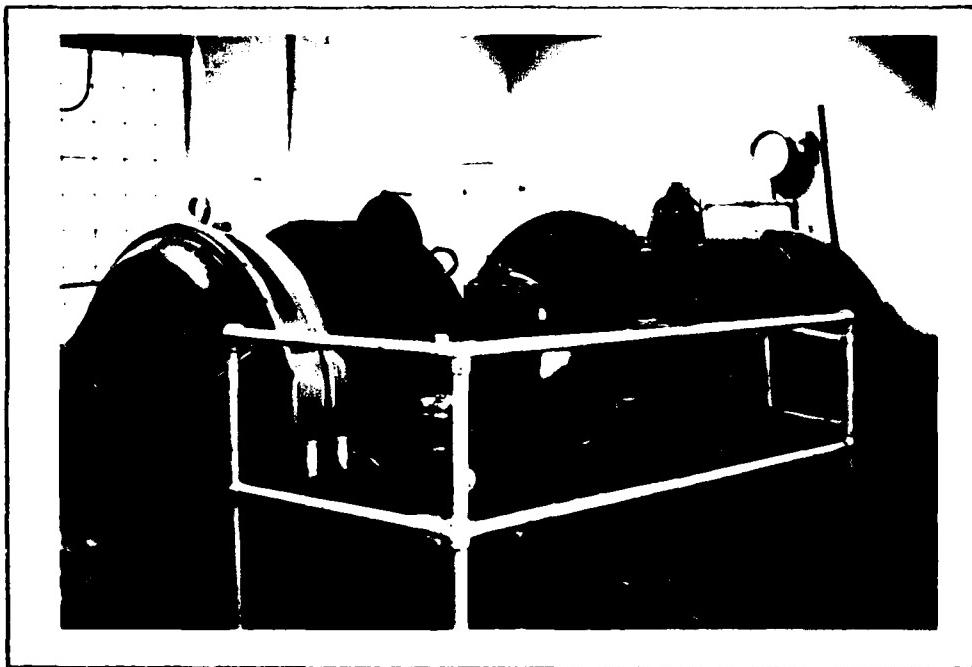
13. POWER HOUSE TO THE LEFT AND PUMP HOUSE TO THE RIGHT ABOUT 100 FEET DOWNSTREAM OF THE DAM. (11/13/79)



14. DOWNSTREAM SIDE OF THE POWER HOUSE WITH THE TAILRACE IN THE FOREGROUND. (11/13/79)



15. INSIDE THE POWER HOUSE SHOWING THE GATE HOIST PEDESTALS IN THE BACKGROUND AND THE POWERED HOIST UNIT IN THE FOREGROUND. (11/13/79)



16. ELECTRIC POWER GENERATING UNIT. (11/13/79)



17. POTENTIAL DAMAGE AREA ABOUT 0.5 MILES DOWNSTREAM FROM THE DAM. (11/13/79)



18. POTENTIAL DAMAGE AREA ABOUT 1.0 MILES DOWNSTREAM FROM THE DAM. (11/13/79)



19. POTENTIAL DAMAGE AREA ABOUT 1.9 MILES DOWNSTREAM FROM THE DAM. (11/13/79)



20. POTENTIAL DAMAGE AREA ABOUT 2.1 MILES DOWNSTREAM FROM THE DAM. (11/13/79)



21. POTENTIAL DAMAGE AREA ABOUT 2.1 MILES DOWNSTREAM FROM THE DAM. (11/13/79)



22. POTENTIAL DAMAGE AREA ABOUT 2.1 MILES DOWNSTREAM FROM THE DAM. (11/13/79)

APPENDIX D
HYDROLOGIC AND HYDRAULIC COMPUTATIONS



O'BRIEN & GERE
ENGINEERS, INC.

SUBJECT

Hartford Reservoir #1 Dam

SHEET

BY

DATE

JOB NO

APPENDIX D
HYDROLOGIC & HYDRAULIC COMPUTATIONS
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STAGE-STORAGE & STAGE-DISCHARGE CURVES	D-4
T _p COMPS., PMP DATA, STAGE-DISCHARGE DATA, STAGE-STORAGE DATA (SOUTH FLOOD CONTROL RESERVOIR DAM)	D-5
T _p COMPS., PMP DATA, STAGE-STORAGE DATA (HARTFORD RES #2 DAM)	D-6
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TOP OF DAM & SPWY. EL. VIEW & STAGE-DISCHARGE DATA (HARTFORD RES. #3 DAM)	D-11
VALLEY X-SEC. BETWEEN HARTFORD RES. #1 & #5 DAMS	D-12
VALLEY X-SEC. BETWEEN HARTFORD RES. #1 & #3 DAMS	D-12
X-SEC AT HAZARD AREA 2000 FT. DOWNSTREAM OF HARTFORD RES #1 DAM	D-13

SUBJECT

Hartford Reservoir #1 Dam

SHEET

BY

DATE

JOB NO

APPENDIX D

HYDROLOGIC & HYDRAULIC COMPUTATIONS

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HEC-I DAM SAFETY VERSION COMPUTER OUTPUT WITH DAM BREACH	D-36
RES. SURFACE AT TOP OF DAM ROUTED TO DOWNSTREAM DAMAGE CENTER	to D-39
HEC-I DAM SAFETY VERSION COMPUTER OUTPUT WITH DAM BREACH	D-40
RES. SURFACE AT PRIMARY SPILLWAY CREST ROUTED TO DOWNSTR. DAMAGE CENTER	to D-43

AD-A142 563

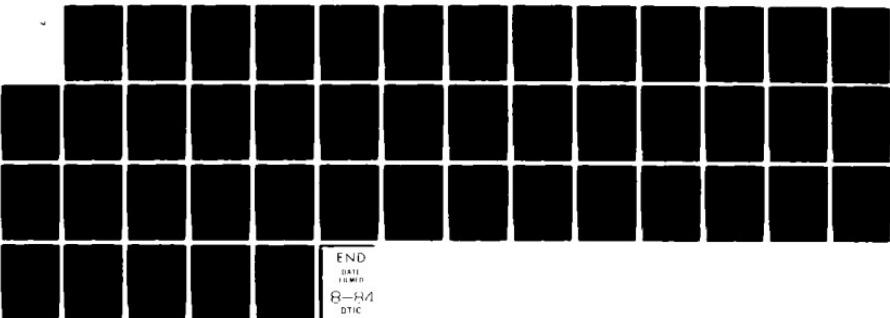
NATIONAL DAM INSPECTION PROGRAM HARTFORD RESERVOIR
NUMBER 1 DAM (CT 00001..(U) CORPS OF ENGINEERS WALTHAM
MA NEW ENGLAND DIV APR 80

2/2

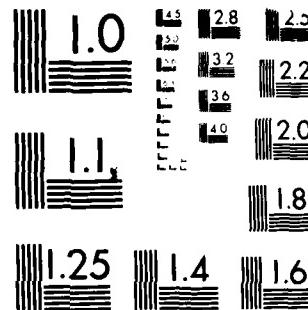
UNCLASSIFIED

F/G 13/13

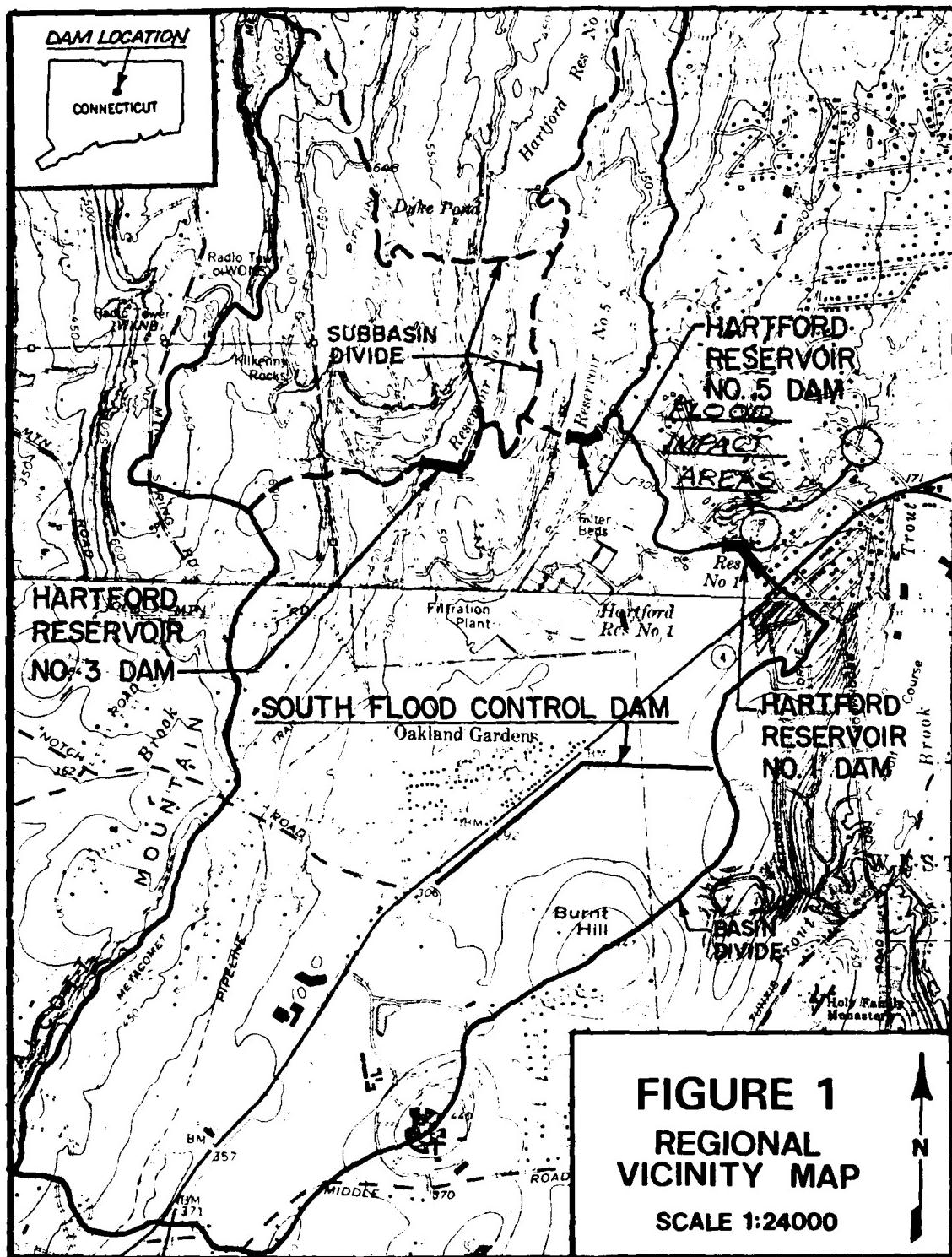
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DATE
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MICROCOPY RESOLUTION TEST CHART
NATIONAL BUREAU OF STANDARDS 1963 A



D-1

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648 Beacon Street
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(617) 247-1800

2060-001
JOB D-2 OF D-43
SHEET NO. 1/17
CALCULATED BY P.G. DATE 1/17
CHECKED BY R.B. DATE 1/180
SCALE

HARTFORD RESERVOIR DAM #1 H&H

DRAINAGE AREA (SUB-BASIN INCLUDING SOUTH RESERVOIR) = 2.23 SQ. MI.

SOUTH RESERVOIR DA = 1.3 SQ. MI.; #1 SUB-AREA = 0.93 SQ. MI.
SNYDER HYDROGRAPH COEFFICIENTS TOTAL DRAINAGE AREA = 3.89 MI.²

$$C_t = 2.0$$

$$C_p = 0.5$$

T_P COMPUTATIONS

$$L = 0.9 \text{ Mi.}$$

$$L_{ca} = 0.4 \text{ Mi.}$$

$$T_p = C_t \times (L \times L_{ca})^3$$

$$T_p = 2 \times (0.9 \times 0.4)^3 \approx \underline{\underline{1.50 \text{ HOURS}}}$$

PMP DATA

FROM HMS #33 THE 24 HOUR 200 Sq.Mi. INDEX RAINFALL IS 21.5

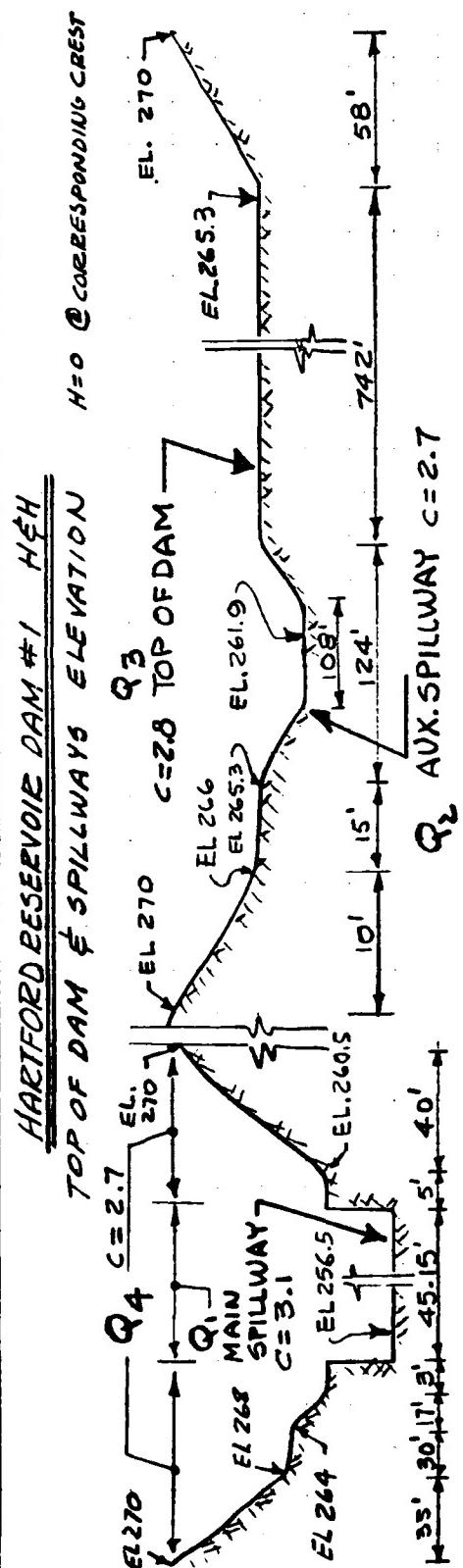
6hr % OF INDEX FOR THIS BASIN	= 111
12hr % " " " "	= 124
24hr % " " " "	= 133

STAGE-STORAGE

	ELEV. (MSL)	AREA (AC.)	STORAGE (AC. FT.) (COMPUTED BY HEC-1 PROGRAM)
NORMHL POOL	225.0	0	0
	256.5	27	284
	260.0	35	392
	270.0	68	898

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BOSTON, MASSACHUSETTS 02215
(617) 247-1800

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CHECKED BY R.B. DATE 2/80
SCALE _____



STAGE DISCHARGE

ELEVATION NEWD	H ft.	Q_1 CFS	H Q_2 CFS	H Q_3 CFS	H Q_4 CFS	ΣQ CFS	
						$Q = C_1 H^{1.5}$	$Q = C_2 H^{1.5}$
256.5	0	0				0	0
257.5	1	140				140	
258.5	2	396				396	
259.5	3	727				727	
260.5	4	1,120				1,120	
261.9	5.4	1,756	0	0	0	0	48
265.3	8.8	3,654	3.4	1,871	0	4.8	604
266.0	9.5	4,098	4.1	2,490	0.7	5.5	6,129
268.0	11.5	5,458	6.1	4,595	2.7	9,404	8,526
270.0	13.5	6,942	8.1	7,149	4.7	21,597	20,832
						2,330	38,018

SUBJECT

STAGE-STORAGE & STAGE-DISCHARGE CURVES

SHEET

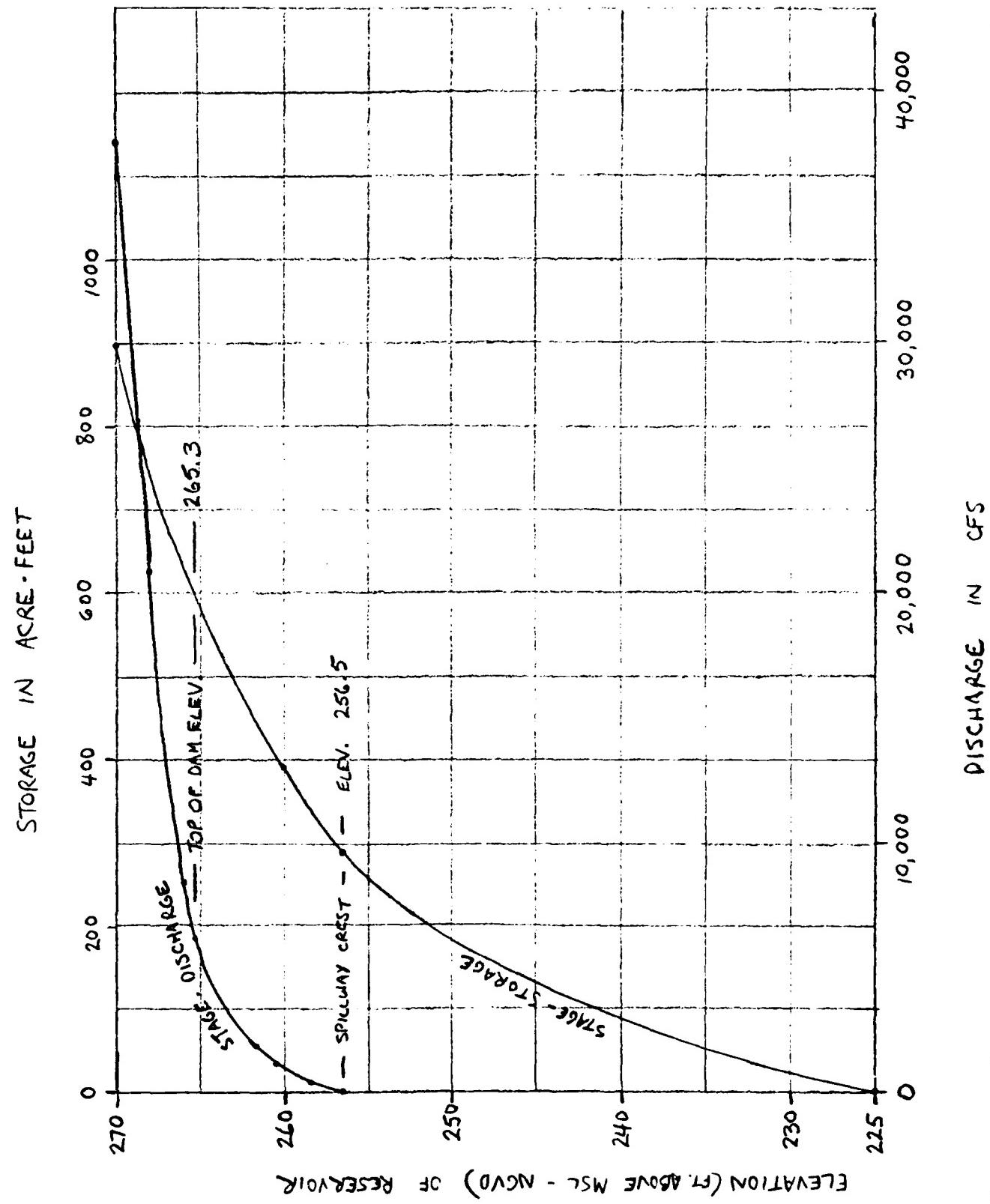
0-4 BY RRB

DATE

3/80

JOB NO

2060-001



SUBJECT	SHEET	BY	DATE	JOB NO
HARTFORD RESERVOIR DAM # 1	0-5	RRB	R.B.	2060-001

SOUTH FLOOD CONTROL RESERVOIR

THE SOUTH FLOOD CONTROL RESERVOIR IS LOCATED UPSTREAM OF HARTFORD RESERVOIR DAM # 1 WITHIN THE DRAINAGE AREA.

$$\text{SUB-AREA DA} = 1.3 \text{ SQ.MI.}$$

$$T_p \text{ COMPS. : } L = 2.0 \text{ MILES} \quad L_{CA} = 0.9 \text{ MILES}$$

$$T_p = C_T (L \cdot L_{CA})^{0.3} = 2.0 (2 \cdot 0.9)^{0.3} = \underline{2.4 \text{ HOURS}} ; C_p = \underline{0.5}$$

PMP DATA : FROM HMS # 33, 24 HR. 200 SQ.MI. INDEX RAINFALL = 21.5 INCHES

$$6 \text{ HR. RATIO} = 111\%$$

$$12 \text{ HR. RATIO} = 124\%$$

$$24 \text{ HR. RATIO} = 133\%$$

STAGE-DISCHARGE DATA (OBTAINED FROM MDC)

PRINCIPAL SPILLWAY DISCHARGE CAPACITY = 114 CFS (CREST ELEV. \approx 264)

EMERGENCY SPILLWAY \rightarrow 120 FT. CREST LENGTH; 3:1 SIDE SLOPES; CREST ELEV. = 284.7 (DISCHARGES CALCULATED FROM DWG. ES-24, SCS HYDRAULICS HANDBOOK 5)

TOP OF DAM ELEVATION = 289.5,
LENGTH \approx 2000 FT., C \approx 2.9

RESERVOIR SURF. ELEV.	<u>Q_P (CFS)</u>	<u>H_E (FT.)</u>	<u>d_c (FT.)</u>	<u>Q_E (CFS)</u>	<u>H_T00 (FT)</u>	<u>Q_T00 (CFS)</u>	<u>Q_TOTAL (CFS)</u>
264	0	0	0	0	0	0	0
284.7	114	0	0	0	0	0	114
285.5	115	0.8	0.53	276	0	0	391
286.5	116	1.8	1.2	912	0	0	1,028
287.5	117	2.8	1.87	1,824	0	0	1,941
288.5	118	3.8	2.53	2,832	0	0	2,950
289.5	119	4.8	3.2	3,960	0	0	4,079
290	120	5.3	3.53	4,560	0.5	2,050	6,730
292	122	7.3	4.87	7,200	2.5	22,927	30,249

<u>STAGE-STORAGE DATA</u> \rightarrow	<u>ELEV.</u>	<u>SURF. AREA (ACRES)</u>	<u>FLOOD STORAGE (HEC-1 PROCED ACRES-FT.)</u>
	264	7.3	0
	284.7	65	650
	290	75	1,020

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SHEET NO. D-6 OF D-13
CALCULATED BY P.G. DATE 1/50
CHECKED BY R.B. DATE 2/60

HARTFORD RESERVOIR DAM # 1 - UPSTREAM RESERVOIRS SCALE

HARTFORD RESERVOIR DAM #2 H&H

DERAINAGE AREA

$$= 0.81 \text{ Sq.Mi}$$

SNYDER HYDROGRAPH COEFFICIENTS

THIS DRAINAGE AREA REFLECTS THE EFFECTS OF
DRAINAGE FROM A PORTION OF THE
TALCOTT FLOOD CONTROL RESERVOIR
LOCATED UPSTREAM OF HARTFORD
RESERVOIR #2.

$$C_L = 2.0$$

$$C_P = 0.5$$

T_p COMPUTATIONS

$$L = 1.0 \text{ Mi.}$$

$$L_{ca} = 0.4 \text{ Mi.}$$

$$T_p = C_L \times (L \times L_{ca})^3$$

$$T_p = 2 \times (1.0 \times 0.4)^3 \approx 3.5 \text{ HOURS}$$

PMP DATA

FROM HMS #33 THE 24 HOUR, 200 Sq.Mi. INDEX RAINFALL IS 21.5

6hr% OF INDEX FOR THIS BASIN

= 111

12hr% " " " "

= 124

24hr% " " " "

= 133

STAGE STORAGE

SURCHARGE CAPACITY

ELEV. (NGVD)	AREA (AC)	STORAGE (A-FT.) (COMPUTED BY HEC-3 PROGRAM)
NORMAL POOL 385.3	44	0
390.0	52	225
400.0	70	833

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JOB

0-7

3-43

SHEET NO

CALCULATED BY P.G.

1/50

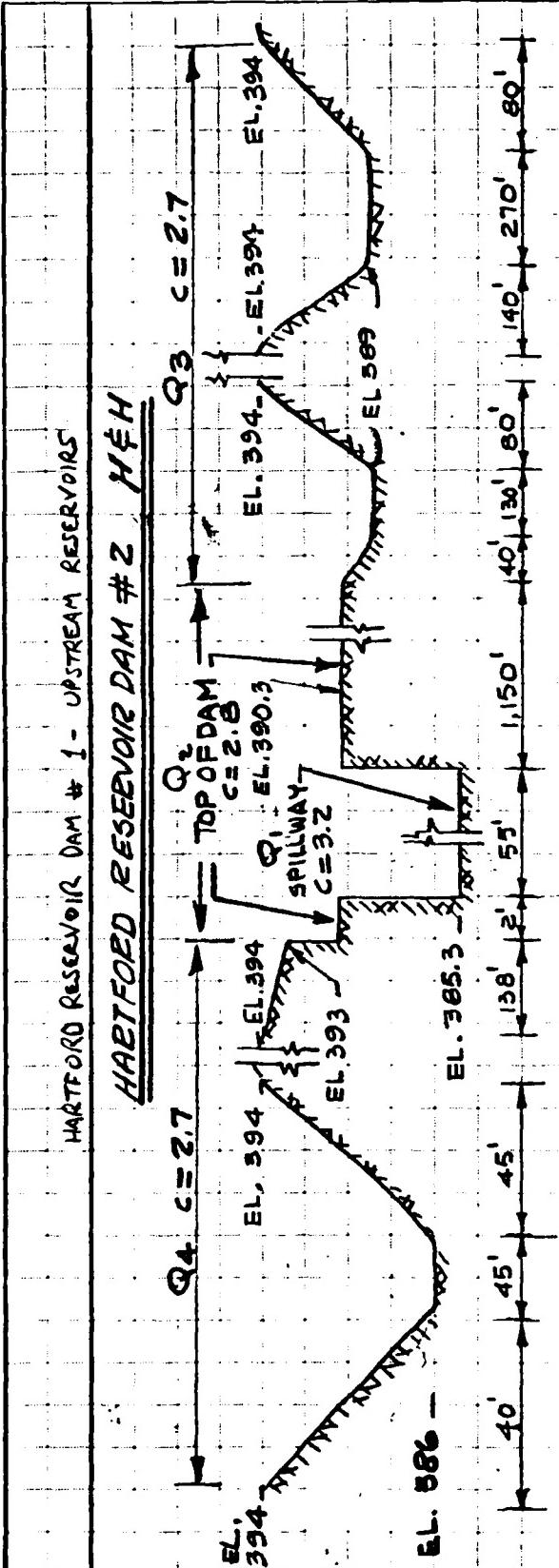
SEARCHED BY R. B.

1750

CHECKED BY _____ DATE _____

2/80

SCALE



$$Q = C_L H^{1.5} \quad H = 0. \quad @ \text{ CORRESPONDING CEST}$$

ELEVATION NGVD	H. Q ₁ CFS	H. Q ₂ CFS	H. Q ₃ CFS	H. Q ₄ CFS	H. Q ₅ CFS	H. Q ₆ CFS	H. Q ₇ CFS	H. Q ₈ CFS	H. Q ₉ CFS	H. Q ₁₀ CFS	H. Q ₁₁ CFS	H. Q ₁₂ CFS	H. Q ₁₃ CFS	H. Q ₁₄ CFS	H. Q ₁₅ CFS
385.3	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
386.0	1.7	103	390	781	1,253	1,968	0	1.3	1,634	4.3	1,277	4,879			
387.0	3.7	388.0	2.7	389.0	5.0	390.0	7.150	3.0	5,920	6.0	2,247	18,369			
							3,052	1.7	14,310	4.0	9,294	2,940	30,304		
									3,760	2.7	7,0	3,724	8.0	13,247	44,444
										3.7	22,957	5.0	1/3	247.3	8.0

NOTE: ABOVE 394.0 PRESERVE #2 SPICES INTO PRESERVE #3

BRYANT ASSOCIATES, INC.
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SHEET NO. 0-8 OF D-43
CALCULATED BY P.G. DATE 1/80
CHECKED BY R.B. DATE 2/80

HARTFORD RESERVOIR DAM #1 - UPSTREAM RESERVOIRS

SCALE

HARTFORD RESERVOIR DAM #5 H&H

DERAINAGE AREA (SUB AREA) = 0.21 Sq.Mi
TOTAL DRAINAGE AREA = 3.89 SQUARE MILES

SNYDER HYDROGRAPH COEFFICIENTS

$$C_t = 2.0$$

$$C_p = 0.5$$

T_p COMPUTATIONS

$$L = 0.57 \text{ Mi.}$$

$$L_{ca} = 0.15 \text{ Mi.}$$

$$T_p = C_t \times (L \times L_{ca})^{.3}$$

$$T_p = 2 \times (0.57 \times 0.15)^{.3} \approx 0.96 \text{ HOURS}$$

USE T_p = 1.0 HOURS

PMP DATA

FROM HMS #33 THE 24 HOUR 200 Sq.Mi. INDEX RAINFALL IS 21.5

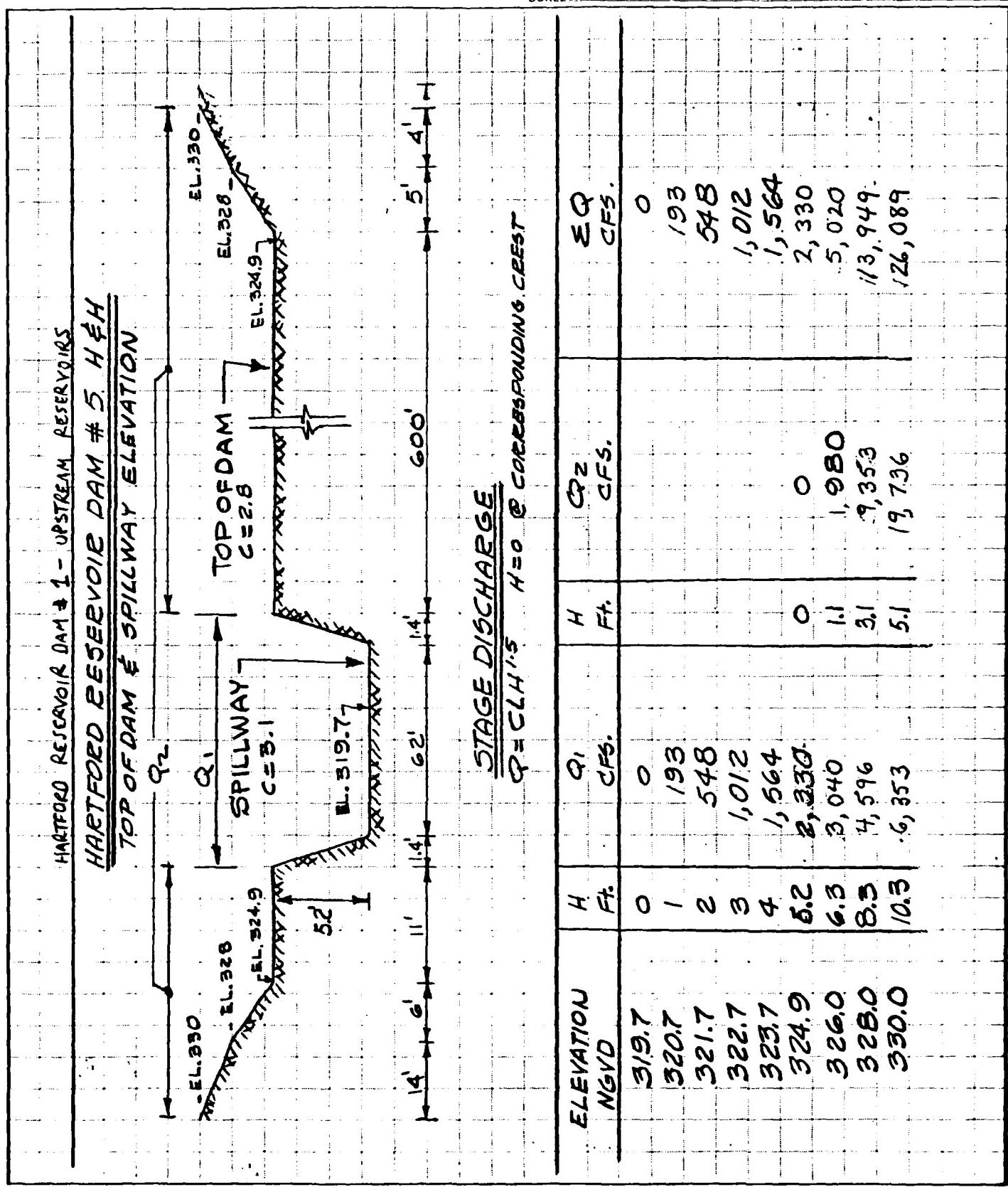
6hr%	OF INDEX FOR THIS BASIN	= 111
12hr%	" " "	= 124
24hr%	" " "	= 133

STAGE STORAGE

	ELEV. (MSL)(N.Y.60)	AREA (AC.)	STORAGE (AC.FA) (COMPUTED BY HEC-1 PROGRAM)
NORMAL POOL	301.0	0	0
	319.7	25	156
	330.0	37	473

BRYANT ASSOCIATES, INC.
648 Beacon Street
BOSTON, MASSACHUSETTS 02215
(617) 247-1800

JOB 2060-001
SHEET NO D-9 OF D-43
CALCULATED BY P.G. DATE 1/80
CHECKED BY R.B. DATE 2/80
SCALE



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648 Beacon Street
BOSTON, MASSACHUSETTS 02215
(617) 247-1800

JOB 2060-001
SHEET NO. D-10 OF D-43
CALCULATED BY R.G. DATE 1/60
CHECKED BY R.B. DATE 2/80

HARTFORD RESERVOIR DAM # 1 - UPSTREAM RESERVOIRS

SCALE

HARTFORD RESERVOIR DAM # 3 H&H

SUB-BASIN
DRAINAGE AREA = 0.58 Sq.Mi
TOTAL WATERSHED = 3.89 SQUARE MILES

SNYDER HYDROGRAPH COEFFICIENTS

$$C_L = 2.0$$

$$C_P = 0.5$$

T_P COMPUTATIONS

$$L = 1.21 \text{ Mi.}$$

$$L_{ca} = 0.40 \text{ Mi.}$$

$$T_P = C_L \times (L \times L_{ca})^3$$

$$T_P = 2 \times (1.21 \times 0.40)^3 \approx 1.60 \text{ HOURS}$$

PMP DATA

FROM HMS #33 THE 24 HOUR 200 Sq.Mi. INDEX RAINFALL IS 21.5

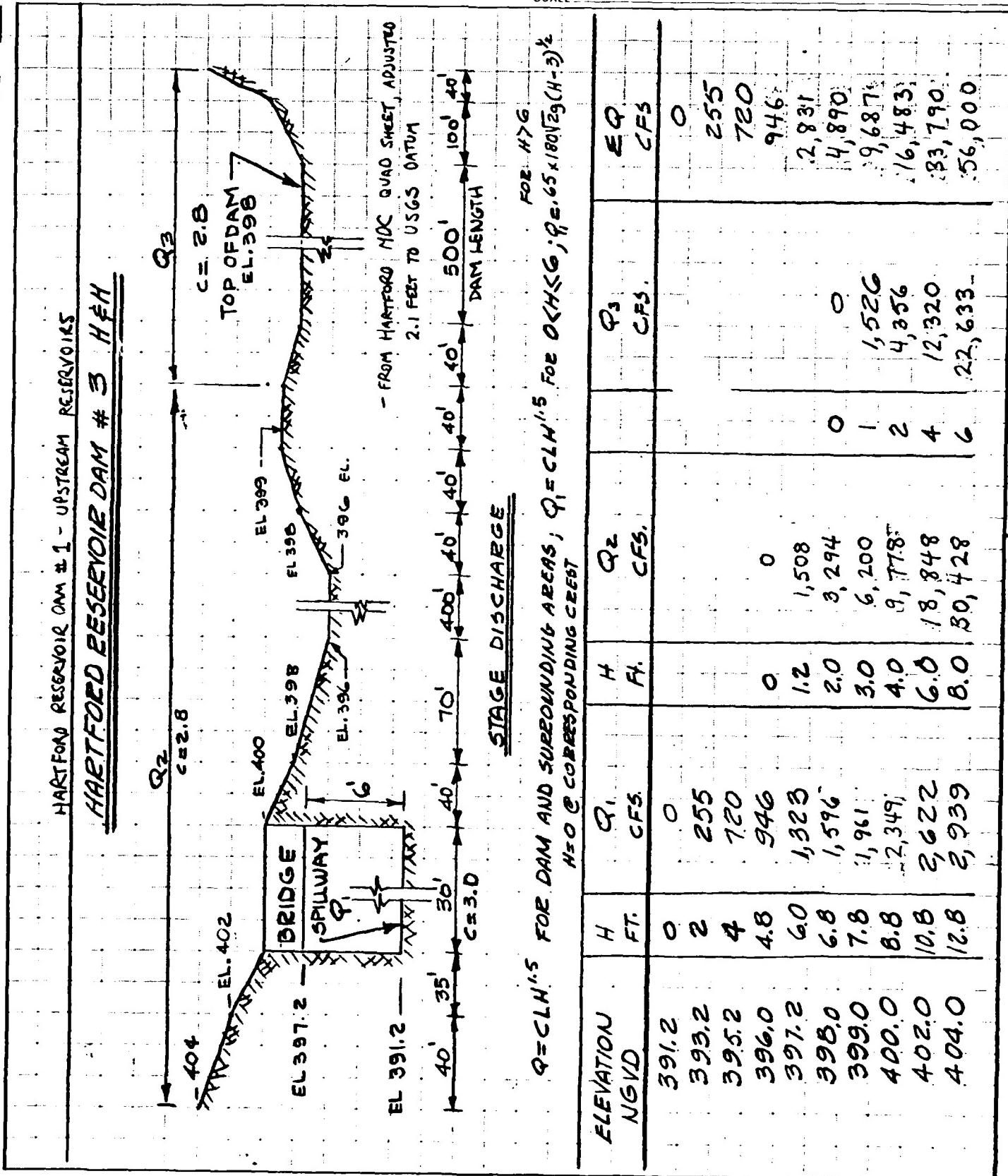
6hr%	OF INDEX FOR THIS BASIN	= 111
12hr%	" " "	= 124
24hr%	" " "	= 133

STAGE STORAGE

ELEV. (NGVD)	AREA (AC.)	STORAGE (AC.FT.) (COMPUTED BY HEC-1 PROGRAM)
355	0	0
NORMAL POOL - 391.2	28	338
400	40	636

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JOB 2060 - 001
SHEET NO. D-11 OF D-43
CALCULATED BY R.G. DATE 1/80
CHECKED BY R.B. DATE 2/80
SCALE



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(617) 247-1800

JOB

SHEET NO.

CALCULATED BY

CHECKED BY

SCALE

Z 060 - 001

D-12

OF

D-43

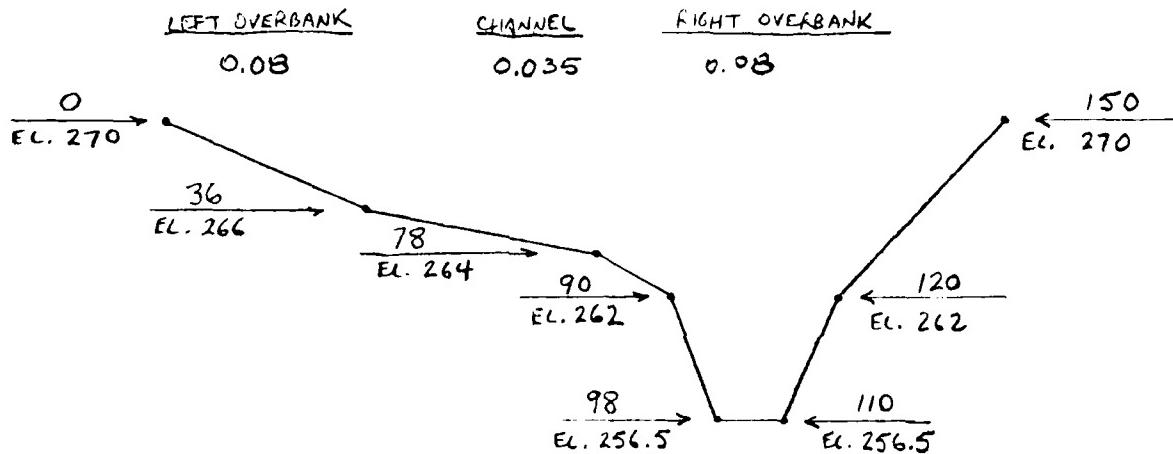
1/80

2/80

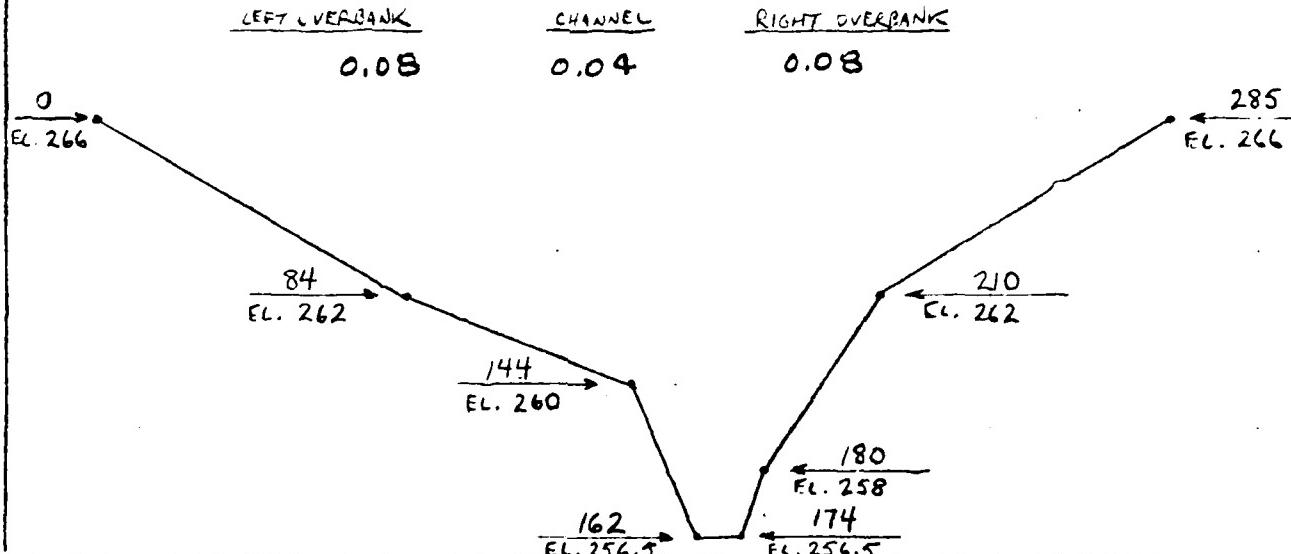
DATE

HARTFORD RESERVOIR DAM #1 H & H cont'd

- 1) VALLEY X-SEC. BETWEEN RESERVOIR #1 & #5
CHANNEL LENGTH = 2,200'
SLOPE = 0.025



- 2) VALLEY X-SEC BETWEEN RESERVOIR #1 & #3
CHANNEL LENGTH = 6,000'
SLOPE = 0.025

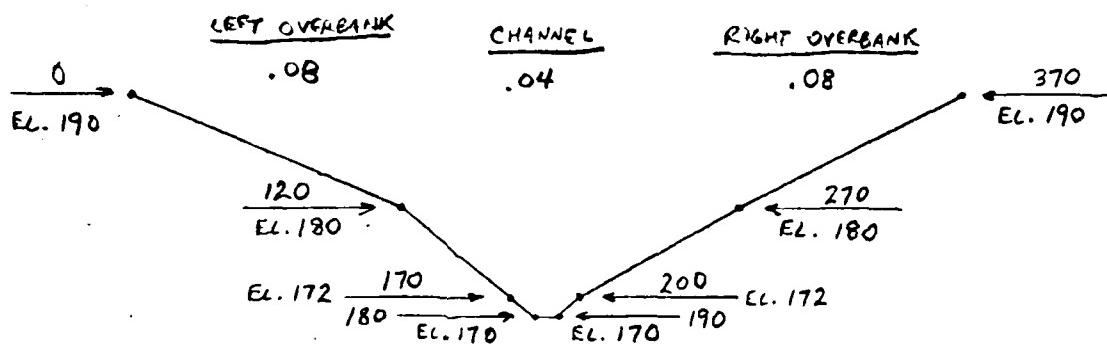


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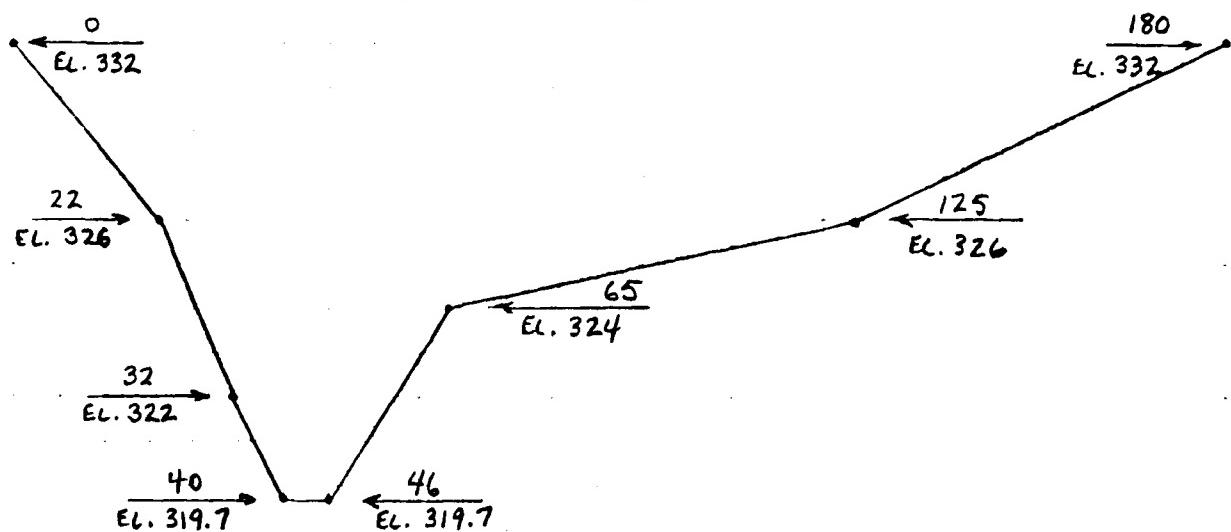
JOB 2060-001
SHEET NO. D-13 OF D-43
CALCULATED BY RRB DATE 1/50
CHECKED BY R.B. DATE 2/60
SCALE ..

HARTFORD RESERVOIR DAM #1-H EH Cont'd.

(3) CROSS-SECTION AT HAZARD AREA D6-1
2,000' DOWNSTREAM OF DAM #1
SLOPE OF CHANNEL = 0.025

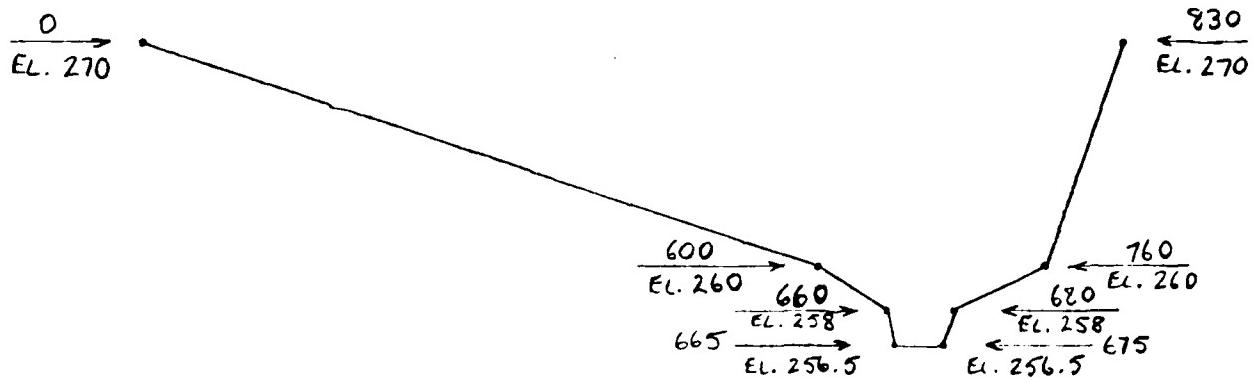


(4) VALLEY X-SEC BETWEEN RESERVOIR #5 & RESERVOIR #2:
CHANNEL LENGTH = 1,350'
SLOPE = 0.04



SUBJECT	SHEET	BY	DATE	JOB NO
HARTFORD RESERVOIR DAM # 1	D-14	RRB	2/80	2060-001

CHANNEL CROSS-SECTION BETWEEN SOUTH RESERVOIR AND RES. NO. 1



CHANNEL LENGTH = 1,300 FEET

CHANNEL SLOPE = .006 FT./FT.

MANNING'S COEFFICIENTS : OVERBANKS \rightarrow .08

CHANNEL \rightarrow .04

FLOOD ROUTINGS THROUGH HARTFORD RESERVOIR #1
WITHOUT DAM BREACH

FLOOD HYDROSHAM PACKAGE (HEC-1)
DAM SAFETY VENUE JULY 1974

LAST MODIFICATION 26 FEB 79

INPUT

HYDROSHAM INPUT DATA NO. 1									
NATIONAL DAM INSPECTION PROGRAM NEW ENGLAND DIVISION - COUNS OF ENGINEERS									
2	A2	HYDROSHAM INPUT DATA NO. 1							
3	A3								
4	300								
5	0								
6	H1	0							
7	J	0							
8	K	0							
9	K1	INFLOW TO RESERVOIR 2							
10	K2	ROUTED OUTFLOW FROM RESERVOIR 2							
11	K3	INFLOW TO CHANNEL ROUTING 2 TO 5							
12	K4	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
13	K5	INFLOW TO CHANNEL ROUTING 2 TO 5							
14	K6	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
15	K7	INFLOW TO CHANNEL ROUTING 2 TO 5							
16	K8	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
17	Y1	INFLOW TO CHANNEL ROUTING 2 TO 5							
18	Y2	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
19	Y3	INFLOW TO CHANNEL ROUTING 2 TO 5							
20	Y4	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
21	Y5	INFLOW TO CHANNEL ROUTING 2 TO 5							
22	Y6	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
23	Y7	INFLOW TO CHANNEL ROUTING 2 TO 5							
24	Y8	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
25	Y9	INFLOW TO CHANNEL ROUTING 2 TO 5							
26	Y10	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
27	Y11	INFLOW TO CHANNEL ROUTING 2 TO 5							
28	Y12	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
29	Y13	INFLOW TO CHANNEL ROUTING 2 TO 5							
30	Y14	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
31	Y15	INFLOW TO CHANNEL ROUTING 2 TO 5							
32	Y16	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
33	Y17	INFLOW TO CHANNEL ROUTING 2 TO 5							
34	Y18	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
35	Y19	INFLOW TO CHANNEL ROUTING 2 TO 5							
36	Y20	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
37	Y21	INFLOW TO CHANNEL ROUTING 2 TO 5							
38	Y22	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
39	Y23	INFLOW TO CHANNEL ROUTING 2 TO 5							
40	Y24	ROUTED OUTFLOW FROM CHANNEL ROUTING 2 TO 5							
41	K1	ROUTED OUTFLOW FROM RESERVOIR 5							
42	K2	TOTAL CHANNEL ROUTING 2 TO 5							
43	K3	ROUTED OUTFLOW FROM RESERVOIR 5							
44	K4	ROUTED OUTFLOW FROM RESERVOIR 5							
45	K5	ROUTED OUTFLOW FROM RESERVOIR 5							
46	K6	ROUTED OUTFLOW FROM RESERVOIR 5							
47	K7	ROUTED OUTFLOW FROM RESERVOIR 5							
48	K8	ROUTED OUTFLOW FROM RESERVOIR 5							
49	K9	ROUTED OUTFLOW FROM RESERVOIR 5							
50	K10	ROUTED OUTFLOW FROM RESERVOIR 5							

INPUT (CONT.)

PREVIEW OF THE SEQUENCE OF STREAM METALLURGICAL CALCULATIONS

HYDROGRAPHIC ROUTING

LLWAY CREST ELEVATION → 365.3		CHET	SAT-100	0.0
CAPACITY =	0.	225.	0.33.	
ELEVATION =	345.	390.	400.	
PEAK OUTFLOW IS	313.	AT TIME	10.50	HOURS
PEAK OUTFLOW IS	480.	AT TIME	14.50	HOURS
PEAK OUTFLOW IS	672.	AT TIME	18.25	HOURS
PEAK OUTFLOW IS	856.	AT TIME	18.25	HOURS
PEAK OUTFLOW IS	1035.	AT TIME	18.25	HOURS
PEAK OUTFLOW IS	1221.	AT TIME	19.00	HOURS
PEAK OUTFLOW IS	1413.	AT TIME	18.00	HOURS
PEAK OUTFLOW IS	1594.	AT TIME	18.00	HOURS
PEAK OUTFLOW IS	1672.	AT TIME	18.00	HOURS

ROUTED OUTFLOWS
FROM H.R. # 2
FOR VARIOUS
FLOWS

FLOOD ROUTING FROM H.R. #2
TO H.R. #5

CHANNEL ROUTING 2 TO 5

ISLAW	TCMPD	TECON	TTAPE	JPLT	JPHL	INAME	IStage	IAUTO
CH4-1	1	0	0	0	0	0	0	0
LOSS	CLOSS	Avg	IMES	ISME	TOP	IPMP	LSPR	
0.0	0.000	0.00	1	1	0	0	0	

NSTPS	NSFL	LAG	ANSK	X	TSK	STORA	ISPRAT
1	0	0	0.000	0.000	0.000	-1.	0

CHANNEI CHARACTERISTICS

CHANNEI SECTION 4-T { STAGE - STORAGE AND UPSTREAM END OF H.R. #5 }

CHANNEI SECTION 4-T { STAGE - DISCHARGE CHARACTERISTICS FOR THE CHANNEL BETWEEN RESERVOIRS 2 & 5 }

CHANNEI SECTION 4-T { STAGE - STORAGE AND UPSTREAM END OF H.R. #5 }

CHANNEI SECTION 4-T { STAGE - DISCHARGE CHARACTERISTICS FOR THE CHANNEL BETWEEN RESERVOIRS 2 & 5 }

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CHANNEI SECTION 4-T { STAGE - DISCHARGE CHARACTERISTICS FOR THE CHANNEL BETWEEN RESERVOIRS 2 & 5 }

CHANNEI SECTION 4-T { STAGE - DISCHARGE CHARACTERISTICS FOR THE CHANNEL BETWEEN RESERVOIRS 2 & 5 }

LOCAL RUNOFF To
HARTFORD RESERVOIR #5

INFLOW TO HES. S LESS RES. 2

HYDROGRAPH

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HYDROGRAPHIC SURVEY

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5 JULY

INFAC AREA = 0. 25. 37. } CIVIL ENGINEERING DATA

CAPACITY = 0. 156. %/3. 31 AUGUST 1974 FOR H.R. #5 DAM

—THE SAVAGE—

MY CREST ELEVATION → 344.4

DATA FORM

TOP OF DAM ELEVATION 324.9

Afterwards he became a member of the Royal Society.

—difficult to find; but it may

- 474 -

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ROUTE OUTLETS below

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W. W. L.

D-22

FLOOD ROUTING FROM
HARTFORD RESERVOIR #5 CHANNEL ROUTING FROM RES. 5 TO RES. 1

	ISIEN	ICOMP	ISCON	ITAPE	JPF	TNAME	ISIAGE	TAUTO
DS-B	0	0	0	0	0	0	0	0
ROUTING DATA								
RES5	0.0	0.00	0.00	0.00	0	0	0	0
RES1	1	0	0	0.000	0.000	STORM	ISPAFF	

NOMINAL DEPTH CHANNEL AND TURB.

0.0000 0.0000 0.0000 ELEV. ELEM. ELEM. SET } CHANNEL CHARACTERISTICS FOR CHANNEL BETWEEN
0.0350 0.0800 256.5 270.0 2200. 0.2500 } RESERVOIRS 5 AND 1

CHUSS SECTION COORDINATES--STA. ELEV--ETC
110.00 256.50 120.00 262.00 150.00 270.00 } CHANNEL CROSS-SECTION AT
110.00 256.50 120.00 262.00 150.00 270.00 } UPSTREAM END OF RESERVOIR #1

STORAGE	0.00	1.00	1.00	1.00	1.00	1.00	1.00	1.00
OUTFLOW	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
STORM	246.00	3036.00	3951.00	4041.43	6092.04	7403.76	AR70.55	10495.92
STORM	263.61	264.32	265.03	265.74	266.45	267.16	267.87	268.58
STORM	246.00	3036.00	3951.00	4041.43	6092.04	7403.76	AR70.55	10495.92

MAXIMUM STAGE IS 259.6

MAXIMUM STAGE IS 260.3 } PEAK WATER ELEVATIONS
MAXIMUM STAGE IS 261.4 } IN CHANNEL FOR
MAXIMUM STAGE IS 261.4 } VARIOUS FLOODS
MAXIMUM STAGE IS 262.0 }

MAXIMUM STAGE IS 263.3 }
0- MAXIMUM STAGE IS 263.3 }

HYDROGRAPH ROUTING

ROUTED OUTFLOW FROM HARTFORD RESERVOIR #3									
ISLNU	ICNUU	IECON	LTAPE	JPLT	JPHI	I NAME	I STAGE	I AUTO	MANU
0.0	0.000	0.00	0.00	0.00	0.00	LSTA	0	0	0
ULLOSS	CLOSUS	AVIS	ISNAME	TOPR	TOPW				
NSIPS	NSTUL	LAG	AMSKK	TSK	STURA	ISPRAT			
STAGE	391.20	393.20	394.00	397.20	398.00	399.00	400.00	402.00	404.00
FLOW	0.00	255.00	720.00	946.00	2431.00	4890.00	9487.00	16493.00	33790.00
									56000.00

STAGE - DISCHARGE DATA

#3 DAM

SURFACE AREA = 0. 2H. 4U.
CAPACITY = 0. 33H. 0.36.
ELFARLUN = 355.

SPILLWAY CREST ELEVATION → 391.2
PEAK OUTFLOW IS 145. AT TIME 19.05 HOURS
PEAK OUTFLOW IS 216. AT TIME 19.05 HOURS
PEAK OUTFLOW IS 407. AT TIME 19.00 HOURS
PEAK OUTFLOW IS 521. AT TIME 19.00 HOURS
PEAK OUTFLOW IS 632. AT TIME 18.75 HOURS
PEAK OUTFLOW IS 744. AT TIME 18.75 HOURS
PEAK OUTFLOW IS 866. AT TIME 18.75 HOURS
PEAK OUTFLOW IS 1076. AT TIME 18.50 HOURS
D - PEAK OUTFLOW IS 1235. AT TIME 18.00 HOURS

ROUTED OUTFLOW FROM H.R. #3 DAM
FOR VARIOUS FLOODS

DAM DATA
TOP OF GATE ELEVATION → 395.0
TOWEL COUL EXPD DAMID

PEAK OUTFLOW IS 145. AT TIME 19.05 HOURS

PEAK OUTFLOW IS 216. AT TIME 19.05 HOURS

PEAK OUTFLOW IS 407. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 521. AT TIME 19.00 HOURS

PEAK OUTFLOW IS 632. AT TIME 18.75 HOURS

PEAK OUTFLOW IS 744. AT TIME 18.75 HOURS

PEAK OUTFLOW IS 866. AT TIME 18.75 HOURS

PEAK OUTFLOW IS 1076. AT TIME 18.50 HOURS

FLOOD ROUTING FROM HARTFORD RESERVOIR #3 CHANNEL ROUTING FROM HFS. 3 TO HFS. 1

1000.0

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CHARACTERISTICS OF CHANNEL BETWEEN PESSEYORES 3 AND 7

CHANNEL CROSS-SECTION AT UPSTREAM END OF RESERVOIR #1		STAGE-STORAGE AND STAGE-DISCHARGE DATA FOR THE CHANNEL	
STATION	ELEVATION	STATION	ELEVATION
OUTFLW	0.00	23.90	42.40
STAGE	256.50	271.50	254.50
FLOW	0.00	23.40	41.40

MAXIMUM STAGE IS	259.0	MAXIMUM WATER ELEVATIONS IN CHANNEL FOR WADERS
MAXIMUM STAGE IS	259.0	
MAXIMUM STAGE IS	259.4	
MAXIMUM STAGE IS	259.7	
MAXIMUM STAGE IS	259.0	
MAXIMUM STAGE IS	259.3	

LOCAL RUNOFF TO SOUTH
FLOOD CONTROL RESERVOIR

INFLOW TO SOUTH FLOOD CONTROL RESERVOIR

ISAN	ICOM	IECON	ITAPE	JPLT	IPAT	INAME	IStage	IAUTO
1-5FCN	0	0	0	0	0	0	1	0
HYDROGRAPH DATA								
TBNG	TBNG	TANTA	SHAD	TRSDA	TRSPC	RATIO	ISNU	ISAME
1.00	1.00	1.00	1.00	1.00	1.00	0.000	0	0
PRECIP DATA								
0.00	21.50	111.00	128.00	133.00	0.00	0.00	0.00	0.00
TRSPC COMMITTED BY THE PREVIOUS IS-AHU								

LOSS DATA
LWPT STMMH DLTMM HRMM EPMM STHMS RTIMR STRTL CNSTL ALSM RTIMP

0 0.00 0.00 1.00 0.00 0.00 1.00 0.00 0.05 0.00 0.00

UNIT HYDROGRAPH DATA
TW= 2.40 CP= .50 NTA= 0

STHMS	-1.70	QHCSN=	-1.10	RTIMR= 2.00
5.	20.	41.	66.	93.
1/4.	162.	150.	134.	120.
37.	35.	32.	30.	27.
11.	16.	15.	14.	13.
6.	7.	7.	7.	7.
2.	2.	1.	1.	1.

END-OF-YEAR00 FLOW
#0.00 MM.MN PERIOD RAIN EXCS LOSS CDM 0 40.0A HR.MN PERIOD RAIN EXCS LOSS CDM 0
SJM 22.0A 21.4A 1.20 710A1
1-5811-1-5511-1-30-1-2049142

QUOTE A ELEM SUUH 31 000 CINTIAI 833382019

STAGE	ISIAD 0-SFCN	ICUMP 1	IECON 0	ITAPE 0	JPLT 0	JPHI 0	IAME 1	IStage 0	IAUTO 0
LOSS	CLSSS 0.0	Avg 0.00	IRES 1	PROFDATA 1	IOPt 1	IPMP 0	LSTR 0		
NIPS	NSIDL 1	LAG 0	ANSK 0	X 0.000	TK 0.000	SIIORA -294.	ISPHAT -1		
STAGE	264.00 0.00	285.50 114.00	286.50 345.00	287.50 402.00	288.50 441.00	289.50 449.00	290.00 459.00	292.00 473.00	DISCHARGE DATA FOR SOUTH FLOOD CONTROL RESERVOIR

SUMFACE AREA =	7.	65.	75.
CAPACITY =	0.	669.	1020.
ELEVATION =	2040.	2045.	2050.

DAM DATA

TOP OF DAM ELEVATION → 2H4.5 0.0 0.0 0.0

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H6. AT TIME 26.15 MINUTES

XVII. 1911.] THE INFLUENCE OF THE SUN ON THE EARTH.

001100 001100 000000 000000

WAK OUTFLUM IS 111. AT TIME 21.50 HOURS SOUTH END OF CAYMAN ISLANDS

RESERVE FOR VARIOUS FLOORS

WATER OUTFLOW IS 334. AT TIME 24.25 MINUTS

THE SOUTHERN STATES

אנו מודים לך על תרומותך וברוך הוא שפָרַע נטהר.

952. AT TIME 21.50 HOURS

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SHINHWA 00.12.11 3ml 51 1673100 2020.11.17

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CHILLU. 5 Hrs. at 11°F. 20.50 MINES

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FLOOD ROUTING FROM SOUTH
FLOOD CONTROL RESERVOIR CHANNEL ROUTING FROM SOUTH RESERVOIR TO RESERVOIR 1
TO HARTFORD RESERVOIR #1

	ISIAN	ICOMP	IECON	ITAPE	JPLT	JNAME	IStage	IAUTO
	DS-C	1	0	ROUTING-DATA	0	0	0	0
LOSS	CLSS	AVG	IRES	ISAME	IOPP	IPMP	LSTR	
0.0	0.000	0.00	1	1	0	0	0	

NSTPS	NSTOL	LAG	AWRK	AWSK	TSK	STOHA	ISPAI
1	0	0	0.000	0.000	0.000	-1.	0

NOTES - DEPTH CHARACTERISTICS

ON(1) ON(2) ON(3) ELNTL HLNTH SEL
0.000 .0000 .0000 270.5 270.0 1300. 0.0660 } CHARACTERISTICS OF CHANNEL BETWEEN SOUTH
580.00 270.00 600.00 260.00 660.00 258.00 665.00 256.50 256.50 } FLOOD CONTROL RESERVOIR AND HARTFORD RESERVOIR #1

CROSS SECTION CHARACTERISTICS							
0.00	270.00	600.00	260.00	660.00	258.00	665.00	256.50
580.00	258.00	760.00	260.00	630.00	270.00	675.00	256.50 }
STORAGE	0.00	.25	.62	1.47	3.35	6.30	10.27 } CHANNEL CROSS-SECTION
	36.25	45.27	55.30	66.34	78.39	91.65	105.51 } AT UPSTREAM END OF H.R. #1
OUTFLOW	0.00	17.90	62.54	154.79	325.89	607.24	1034.83 } 21.24
	577.44	600.94	7644.54	9649.46	11947.33	14426.71	17281.72 } 153.77
							28.24

STAGE	256.50	257.21	257.92	258.63	259.34	260.05	260.76	261.47	262.18	262.89
	263.61	264.32	265.03	265.74	266.45	267.16	267.87	268.58	269.29	270.00 }
FLW	0.00	17.44	62.54	154.79	325.89	607.24	1034.83	1628.31	2404.66	3381.92 }
	577.44	600.94	7644.54	9649.46	11947.33	14426.71	17281.72	20467.14	23997.46	27886.67 }

MAXIMUM STAGE IS 254.0

MAXIMUM STAGE IS	258.1
	259.2

MAXIMUM STAGE IS	259.4
	260.2

MAXIMUM STAGE IS	259.3
	260.1

MAXIMUM STAGE IS	259.4
	260.2

MAXIMUM STAGE IS	261.1
	261.9

D-	29
	MAXIMUM STAGE IS 261.9

STAGE-STORAGE AND

STAGE-DISCHARGE DATA

FOR CHANNEL

THE JOURNAL

ROUTED OUTLET ON FLOW MEASUREMENT

PRINTED IN U.S.A.

ROUTED OUTLETS FROM
MR. #1 DAM FOR
YANKEE FOODS

1940-04-04 - 2011-10-20 61-002-0100-2224
04.04.1940 - 20.10.2011 61-002-0100-2224

PEAK FLOW AND STORAGE (END OF MONTH) SUMMARY FOR MULTIPLE PLANT-RATIO ECONOMIC COMPUTATIONS

OPERATION	STATION	AHTA	PLAN	WATER	WATER	? WATER	Ratio 4	Ratio 5	Ratio 6	Ratio 7	Ratio 8	Ratio 9	PARTS ADDED TO FLOW	
													.20	.30
HYDROGRAPH AT	HAD-2	.61	1	397.	595.	794.	992.	1190.	1389.	1587.	1785.	1984.		
ROUTED TO	HAD-2	.11	1	313.	680.	672.	856.	1035.	1220.	1413.	1599.	1782.		
ROUTED TO	CHA-1	.11	1	481.	672.	856.	1035.	1221.	1413.	1599.	1782.			
HYDROGRAPH AT	HAD-5	.27	1	160.	266.	324.	410.	691.	573.	655.	737.	819.		
2 COMBINED TOTAL		1.06	1	415.	639.	843.	1141.	1381.	1628.	1888.	2139.	2384.		
ROUTED TO	HAD-5	.01	1	382.	600.	842.	1082.	1320.	1555.	1806.	2051.	2288.		
ROUTED TO	05-A	1.01	1	341.	600.	842.	1081.	1320.	1555.	1807.	2048.	2286.		
HYDROGRAPH AT	HAD-3	.58	1	274.	412.	540.	686.	823.	961.	1088.	1235.	1372.		
ROUTED TO	HAD-3	.58	1	185.	286.	407.	521.	632.	744.	864.	1038.	1235.		
ROUTED TO	115-A	.54	1	164.	285.	407.	521.	632.	744.	864.	1038.	1235.		
HYDROGRAPH AT	I-SECH	1.30	1	492.	734.	944.	1230.	1476.	1722.	1984.	2214.	2460.		
ROUTED TO	0-SECH	1.30	1	61.	64.	99.	111.	134.	1652.	1922.	2120.	2376.		
ROUTED TO	05-C	1.30	1	650.	613.	911.	1136.	1367.	1594.	1822.	2050.	2278.		
COMBINED TOTAL		3.60	1	956.	64.	99.	111.	138.	1651.	1921.	2120.	2376.		
D - ROUTED TO	HAD-1	3.60	1	815.	1367.	1946.	2551.	3105.	368.	4213.	4782.	5561.		

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HARTFORD RESERVOIR #2 0 AM

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
STORAGE	385.30	385.30	390.30
OUTFLOW	0.	0.	4879.

PLAN 1 ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
STORAGE	385.30	385.30	390.30
OUTFLOW	0.	0.	4879.

CHANNEL BETWEEN RESERVOIRS 2 AND 5 → PLAN 1 STATION CHA-1

PLAN 1 ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
STORAGE	319.70	319.70	324.90
OUTFLOW	0.	0.	301°

HARTFORD RESERVOIR #5 DAM

PLAN 1 ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
STORAGE	319.70	319.70	324.90
OUTFLOW	0.	0.	2330.

PLAN 1 ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
STORAGE	319.70	319.70	324.90
OUTFLOW	0.	0.	2330.

PLAN 1 ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
STORAGE	319.70	319.70	324.90
OUTFLOW	0.	0.	2330.

PLAN 1 ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
STORAGE	319.70	319.70	324.90
OUTFLOW	0.	0.	2330.

PLAN 1 ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
STORAGE	319.70	319.70	324.90
OUTFLOW	0.	0.	2330.

HARTFORD RESERVOIR #3 DAM

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1 ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
Storage	391.20	391.20	390.00
OUTFLOW	0.	0.	946.

RATIO OF RESERVOIR TO OUTLET	MAXIMUM DEPTH	MAXIMUM STORAGE	MAXIMUM OUTFLOW	DURATION OVER TOP	TIME OF MAX OUTFLOW	TIME OF FAILURE
	FEET	ACFT	CFS	HOURS	MONTHS	MONTHS
.20	392.65	0.00	390.	185.	0.00	19.25
.30	393.33	0.00	390.	296.	0.00	19.25
.40	393.86	0.00	417.	407.	0.00	19.00
.50	394.16	0.00	521.	521.	0.00	19.00
.60	394.32	0.00	632.	632.	0.00	18.75
.70	395.28	0.00	744.	744.	0.00	18.75
.80	395.71	0.00	864.	864.	0.00	18.75
.90	396.46	0.00	984.	984.	0.00	18.75
1.00	396.14	0.00	1236.	1236.	1.75	18.00

CHANNEL BETWEEN RESERVOIRS 3 AND 1

PLAN 1 ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
Storage	264.00	264.00	269.50
OUTFLOW	0.	0.	903.

CHANNEL BETWEEN SOUTH → PLAN 1 STATION 05-A

PLAN 1 ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
Storage	264.00	264.00	269.50
OUTFLOW	0.	0.	4079.

SOUTH FLOOD CONTROL RESERVOIR

PLAN 1 ELEVATION	INITIAL VALUE	SPILLWAY CREST	TOP OF DAM
Storage	264.00	264.00	269.50
OUTFLOW	0.	0.	4079.

RATIO OF RESERVOIR TO OUTLET	MAXIMUM DEPTH	MAXIMUM STORAGE	MAXIMUM OUTFLOW	DURATION OVER TOP	TIME OF MAX OUTFLOW	TIME OF FAILURE
	FEET	ACFT	CFS	HOURS	MONTHS	MONTHS
.20	276.04	0.00	230.	67.	0.00	26.25
.30	277.72	0.00	356.	91.	0.00	26.75
.40	281.97	0.00	446.	99.	0.00	27.25
.50	284.21	0.00	618.	111.	0.00	27.50
.60	285.55	0.00	922.	339.	0.00	28.25
.70	285.91	0.00	729.	652.	0.00	22.50
.80	286.34	0.00	761.	952.	0.00	21.50
.90	287.77	0.00	149.	1242.	0.00	21.00
1.00	287.14	0.00	814.	1616.	0.00	20.50

RATIO OF RESERVOIR TO OUTLET	MAXIMUM DEPTH	MAXIMUM STORAGE	MAXIMUM OUTFLOW	DURATION OVER TOP	TIME OF MAX OUTFLOW	TIME OF FAILURE
	FEET	ACFT	CFS	HOURS	MONTHS	MONTHS
.30	280.	61.	61.	258.0	26.25	
.40	281.	99.	258.1	258.1	26.75	
.50	281.	111.	258.2	27.25		
.60	281.	134.	258.3	27.75		
.70	281.	651.	258.4	28.50		
.80	281.	1242.	260.1	27.50		
.90	281.	1616.	260.6	28.75		
1.00	281.	1811.	261.1	21.00		

FLOOD CONTROL RESERVOIR AND HARTFORD RESERVOIR

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HARTFORD RESERVOIR #1 DAM

SUMMARY OF DAM SAFETY ANALYSIS

PLAN 1

ELEVATION SPILLWAY OUTFLOW	INITIAL VALUE 256.50	SPILLWAY CREST 256.50	TOP OF DAM 265.30
254.0.	254.0.	254.0.	619.
0.	0.	0.	6129.

PLAN 1	ELEVATION SPILLWAY OUTFLOW	INITIAL VALUE 256.50	SPILLWAY CREST 256.50	TOP OF DAM 265.30	MAXIMUM STORAGE AC-F	DURATION OVER TOP MONTHS	MAX OUTFLOW CFS	TIME OF FAILURE MONTHS
-20	259.88	0.00	347.	875.	0.00	0.00	19.50	0.00
-30	261.81	0.00	429.	1367.	0.00	0.00	19.25	0.00
-40	262.01	0.00	458.	1946.	0.00	0.00	19.00	0.00
-50	262.49	0.00	488.	2551.	0.00	0.00	18.75	0.00
-60	262.92	0.00	506.	3105.	0.00	0.00	18.50	0.00
-70	263.35	0.00	525.	3648.	0.00	0.00	18.50	0.00
-80	263.79	0.00	545.	4213.	0.00	0.00	18.50	0.00
-90	264.21	0.00	566.	4782.	0.00	0.00	18.50	0.00
1.00	264.16	0.00	591.	5411.	0.00	0.00	18.50	0.00

SPILLWAY CAPACITYTEST FLOOD ELEVATIONROUTED TEST FLOOD OUTFLOW

PRINTED IN U.S.A.

HARTFORD RESERVOIR # 1 DAM BREACH OUTFLOW (RESERVOIR SURFACE @ TOP OF DAM)
ROUTED TO THE DOWNSTREAM DAMAGE CENTER

INPUT

FLUID HYDRAULIC PACKAGE (HF-C-1)
 DAM SAFETY VERIFICATION JULY 1974
 EAST - MICHIGAN DIVISION - GROUPS OF ENGINEERS

HYDROLOGIC ANALYSIS OF HARTFORD RESERVOIR DAM NO. 1									
NEUTRAL OUTFLOW DUE TO EROSION THROUGH									
NFW EMERGENCY DIVISION - GROUPS OF ENGINEERS									
1	41								
2	42								
3	43								
4	44	300	0	15	0	0	0	-4	0
5	45								
6	46								
7	47								
8	48								
9	49								
10	50								
11	51								
12	52	256.5	257.5	258.5	259.5	260.5	261.0	262.5	264.0
13	53	0	140	140	140	140	140	140	140
14	54	0	27	27	27	27	27	27	27
15	55	224	224	224	224	224	224	224	224
16	56	256.5	256.5	256.5	256.5	256.5	256.5	256.5	256.5
17	57	260.5	260.5	260.5	260.5	260.5	260.5	260.5	260.5
18	58	300	0.01	240	240	240	240	240	240
19	59	300	0.11	240	240	240	240	240	240
20	60								
21	61								
22	62								
23	63								
24	64	0.014	0.014	0.014	0.014	0.014	0.014	0.025	0.025
25	65	0	120	120	120	120	120	120	120
26	66	270	172	172	172	172	172	170	170
27	67	0	0	0	0	0	0	0	0

FLUID MUNICIPAL PACKAGE IMEC-11
DAM SAFETY VERIFICATION
TEST IDENTIFICATION - 29TH FEB '79

DATE TESTED:
TIME TESTED:

NONHARMONIC ANALYSIS OF HAUTFIELD RESERVOIR DAM NO. 1

MATERIAL-DAM INSPECTION WORKSHOP
NE-1 ERLAND DIVISION - COMBOS OF ENGINEERS

JUMP-SPECIFICATION		IPLT		NSTAN	
0.0	NEW	NEW	IPLT	0	0
30.00	0	15	0	-4	0
		JUMP	0	0	0
		THICK	0	0	0
		TRACE	0	0	0
			0	0	0

MULTI-PLAN ANALYSES TO BE PERFORMED
IPLN=2 NRTN=1 LATID=1

NO INFLOW → RATIO=0.00

HYDROGRAPHY RATIONS

WATERFALL PLAN RESERVOIR 1

(STAN)	FCDF	TECF	IPLT	JPLT	JPLT	INMF	INSTAG	IAUTO	IAUTO
HAI-1	1	0	0	0	0	1	0	0	0

ALL PLANS HAVE SAME
WATERFALL DATA

BLDSS	BLDSS	AVG	INPS	INPS	INPS	INPT	INPT	INPT	INPT
0.0	0.000	0.00	1	1	1	0	0	0	0

STATE	STATE	STATE	STATE	STATE	STATE	STATE	STATE	STATE	STATE
STATE	257.50	259.50	259.50	259.50	259.50	259.50	261.90	261.90	265.30
FL14	0.00	140.00	346.00	177.00	1120.00	1804.00	6129.00	6129.00	266.00

SURFACE AREA =	CAPACITY =	SPILLWAY GROSS ELEVATION →	TOP OF DAM ELEVATION →	MAXIMUM BREACH DISCHARGE	DAM BREACH DATA	DAM BREACH DATA	DAM BREACH DATA	DAM BREACH DATA	STAGE - DISCHARGE
0.0	0.0	210.	210.	210.	0.0	0.0	0.0	0.0	DATA

| FLVAR(1)= |
|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|-----------|
| 225. | 225. | 225. | 225. | 225. | 225. | 225. | 225. | 225. | 225. |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

SPILLWAY GROSS ELEVATION →	TOP OF DAM ELEVATION →	MAXIMUM BREACH DISCHARGE	DAM BREACH DATA	STAGE - DISCHARGE					
615.	615.	615.	0.0	0.0	0.0	0.0	0.0	0.0	DATA

| PEAK OUTLINE IS |
|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|-----------------|
| 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 | 0.0 |
| | | | | | | | | | |
| | | | | | | | | | |
| | | | | | | | | | |

TOP OF DAM ELEVATION →	MAXIMUM BREACH DISCHARGE	DAM BREACH DATA	STAGE - DISCHARGE						
265.7	265.7	265.7	265.7	265.7	265.7	265.7	265.7	265.7	DATA

MAXIMUM BREACH DISCHARGE	DAM BREACH DATA	STAGE - DISCHARGE							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	DATA

DAM BREACH DATA	STAGE - DISCHARGE								
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	DATA

STAGE - DISCHARGE	DAM BREACH DATA	STAGE - DISCHARGE							
270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	DATA

DATA	DAM BREACH DATA	STAGE - DISCHARGE							
0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	0.0	DATA

STAGE - DISCHARGE	DAM BREACH DATA	STAGE - DISCHARGE							
270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	DATA

STAGE - DISCHARGE	DAM BREACH DATA	STAGE - DISCHARGE							
270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	DATA

STAGE - DISCHARGE	DAM BREACH DATA	STAGE - DISCHARGE							
270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	DATA

STAGE - DISCHARGE	DAM BREACH DATA	STAGE - DISCHARGE							
270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	270.00	DATA

STAGE - DISCHARGE	DAM BREACH DATA	DAM BREACH DATA	DAM BREACH
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ROUTINE BREACH OUTFLOW
TO DOWNSTREAM HAZARD AREA

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HYDROGRAPH MONITORING						
TO DOWNSTREAM HAZARD AREA						
CROSS-SECTION PONTEVILLE-HAZARD CENTER						
ISLAND	ICUMP	IECON	ITAPE	JPLT	JPAT	I NAME
0.000	0.00	0.00	0.00	0	0	0
ALL PLANS HAVE SAME						
WLSNS	CLSS	AGS	THS	ISME	IOPP	1PHM
0.0	0.000	0.00	0	1	1	0
LSTN						0

مکالمہ علیہ الرسول

STAGE-STORAGE AND
STAGE-DISCHARGE DATA
FOR THE DOWNSTREAM
CHANNEL

HARRINGTON RESERVOIR #1 DAM
REACH 917-918 SPILLWAY DISCHARGE

SUMMARY OF DAM SAFETY ANALYSIS

INITIAL ELEVATION	INITIAL STAGE	SPILLWAY CAPACITY	TOP OF DAM
264.40	256.50	SPILLWAY CAPST	265.30
264.40	284.		265.30
264.40	0.		619.
264.40	593.		6129.

SPILLWAY DISCHARGE CAPACITY

INITIAL ELEVATION	INITIAL STAGE	MAXIMUM SPILLWAY OUTFLOW	DURATION OVER TOP	TIME OF FAILURE
264.40	256.50	0.00	0.00	0.00
264.40	284.	593.	6135.	0.00
264.40	0.	593.	6135.	0.00

SPILLWAY OVERFLOW RESULTS

INITIAL ELEVATION	INITIAL STAGE	SPILLWAY CAPACITY	TOP OF DAM
264.40	256.50	SPILLWAY CAPST	265.30
264.40	284.		619.
264.40	0.		6129.

PEAK SPILLWAY DISCHARGE

INITIAL ELEVATION	INITIAL STAGE	MAXIMUM SPILLWAY OUTFLOW	DURATION OVER TOP	TIME OF FAILURE
264.40	256.50	0.00	0.00	0.00
264.40	284.	593.	6135.	0.00
264.40	0.	593.	6135.	0.00

PEAK BREACH DISCHARGE

INITIAL ELEVATION	INITIAL STAGE	SPILLWAY CAPACITY	TOP OF DAM
264.40	256.50	SPILLWAY CAPST	265.30
264.40	284.		619.
264.40	0.		6129.

BREACH FLOW AT DOWNSTREAM DAMAGE AREA → PLAN 1

INITIAL ELEVATION	INITIAL STAGE	MAXIMUM FLOW/CFS	STAFF FT	TIME HOURS
264.40	256.50	0.00	593.	0.00
264.40	284.	0.00	593.	0.00
264.40	0.	0.00	593.	0.00

SPILLWAY FLOW AT HAZARD AREA → PLAN 1

INITIAL ELEVATION	INITIAL STAGE	MAXIMUM FLOW/CFS	STAFF FT	TIME HOURS
264.40	256.50	0.00	593.	0.00
264.40	284.	0.00	593.	0.00
264.40	0.	0.00	593.	0.00

SPILLWAY FLOW AT HAZARD AREA

INITIAL ELEVATION	INITIAL STAGE	MAXIMUM FLOW/CFS	STAFF FT	TIME HOURS
264.40	256.50	0.00	593.	0.00
264.40	284.	0.00	593.	0.00
264.40	0.	0.00	593.	0.00

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FLOOD MITIGATION PACKAGE (MFPC-1)
DAM SAFETY VERIFICATION JULY 19A
LAST MODIFICATION 26 FEB 19

HARTFORD RESERVOIR #1 DAM BREACH OUTFLOW (RESERVOIR SURFACE AT PRIMARY SPILLWAY CREST)

ROUTED TO DOWNSTREAM DAMAGE CENTER

INPUT

HYDROLOGIC ATTRIBUTES OF HARTFORD RESERVOIR DAM T-0 1									
NATIONAL DAM INSPECTION PROGRAM NE-ENGLAND DIVISION - CHIPS OF ENGINEERS									
1	42	257.5	259.5	260.5	261.0	265.5	265.3	266.0	270.0
2	43	0	180	190	120	100	9129	8925	20532
3	0	300	0	0	0	0	0	0	0
4	0	0	0	0	0	0	0	0	0
5	0	0	0	0	0	0	0	0	0
6	0	0	0	0	0	0	0	0	0
7	0	0	0	0	0	0	0	0	0
8	0	0	0	0	0	0	0	0	0
9	0	0	0	0	0	0	0	0	0
10	0	0	0	0	0	0	0	0	0
11	0	0	0	0	0	0	0	0	0
12	0	0	0	0	0	0	0	0	0
13	0	0	0	0	0	0	0	0	0
14	0	0	0	0	0	0	0	0	0
15	0	0	0	0	0	0	0	0	0
16	0	0	0	0	0	0	0	0	0
17	0	0	0	0	0	0	0	0	0
18	0	0	0	0	0	0	0	0	0
19	0	0	0	0	0	0	0	0	0
20	0	0	0	0	0	0	0	0	0
21	0	0	0	0	0	0	0	0	0
22	0	0	0	0	0	0	0	0	0
23	0	0	0	0	0	0	0	0	0
24	0	0	0	0	0	0	0	0	0
25	0	0	0	0	0	0	0	0	0
26	0	0	0	0	0	0	0	0	0

HYDROGRAPH-ROUTING

ROUTING BREACH OUTFLOW
TO DOWNSTREAM HAZARD CHANNEL ROUTING IN HAZARD CENTER AREA

STAGE	ICOMP	LECON	LIAFE	JPLI	JPRI	INAME	ISAGE	LAUD
Hazard	1	0	0	0	0	1	0	0
LOSS	LOSS	AVIS	IPFS	ISAF	IOPR	IPWD	LSRH	0
0.0	0.000	0.00	1	0	0	0	0	0

WATER HEAD CHARACTERISTICS

QW11	UN(2)	Q(13)	FLNWT	ELMAX	HLNTH	SFL	CHANNEL CHARACTERISTICS
0.000	100.00	0.000	170.0	190.0	2000.	0.25110	

CROSS SECTION CHARACTERISTICS-STAGE ELEVATION-ETC
0.00 100.00 120.00 140.00 160.00 170.00 180.00 190.00 170.00 } CHANNEL CROSS-SECTION AT
200.00 172.00 170.00 190.00 370.00 190.00 } DAMAGE AREA

STORAGE	0.00	7%	1.9%	3.8%	6.5%	10.00	14.20	19.16	24.88	31.37
OUTLET	0.00	41.03	56.52	67.12	74.45	91.70	105.66	120.74	136.95	154.27
OUTLET	12072.00	14976.34	79.43	321.14	822.33	1557.50	2569.67	3921.33	5346.56	7290.94
STAGE	110.00	110.53	112.05	112.11	113.16	174.21	175.20	176.32	177.37	178.42
STAGE	110.53	110.53	112.05	112.63	114.04	164.16	165.79	166.84	167.89	169.05
FLW	0.00	79.43	321.14	422.33	1557.50	2569.67	3921.33	5346.56	7290.94	9531.51
FLW	12072.00	14976.34	12352.02	22223.76	25623.11	31540.21	37124.56	43285.11	50090.16	57567.45

MAXIMUM STAGE IS 174.4 → STREAM ELEVATION AT DAMAGE CENTER

APPENDIX E

INFORMATION AS CONTAINED IN THE NATIONAL INVENTORY OF DAMS

NOT AVAILABLE AT THIS TIME

**DA
FILM**